APPROVED BY DRAFTSMAN | O.G. FIG. CLASS SUBCLASS

FIG. 1

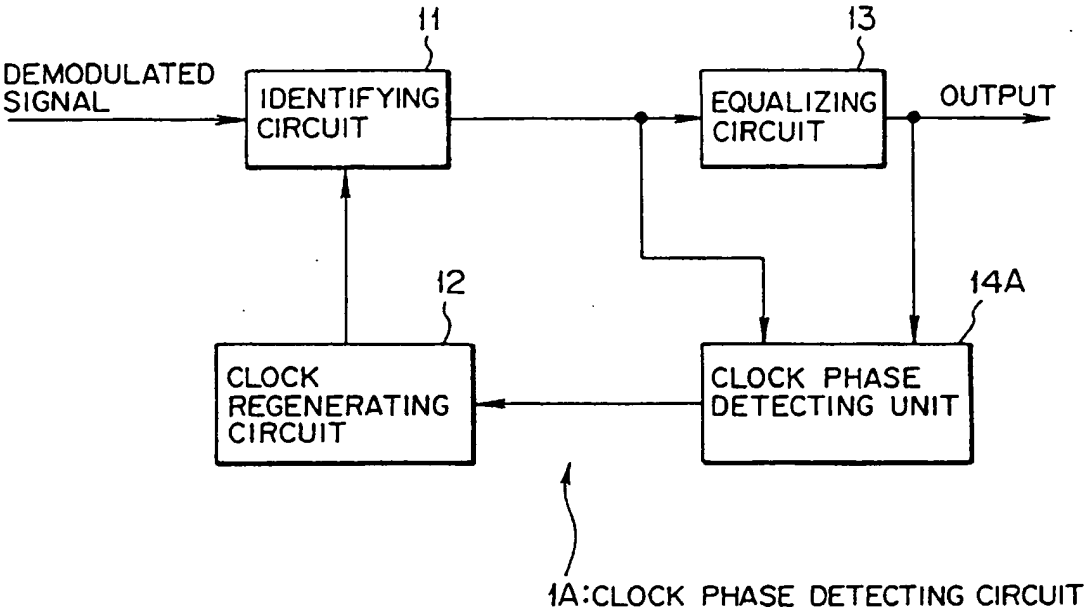


FIG. 2

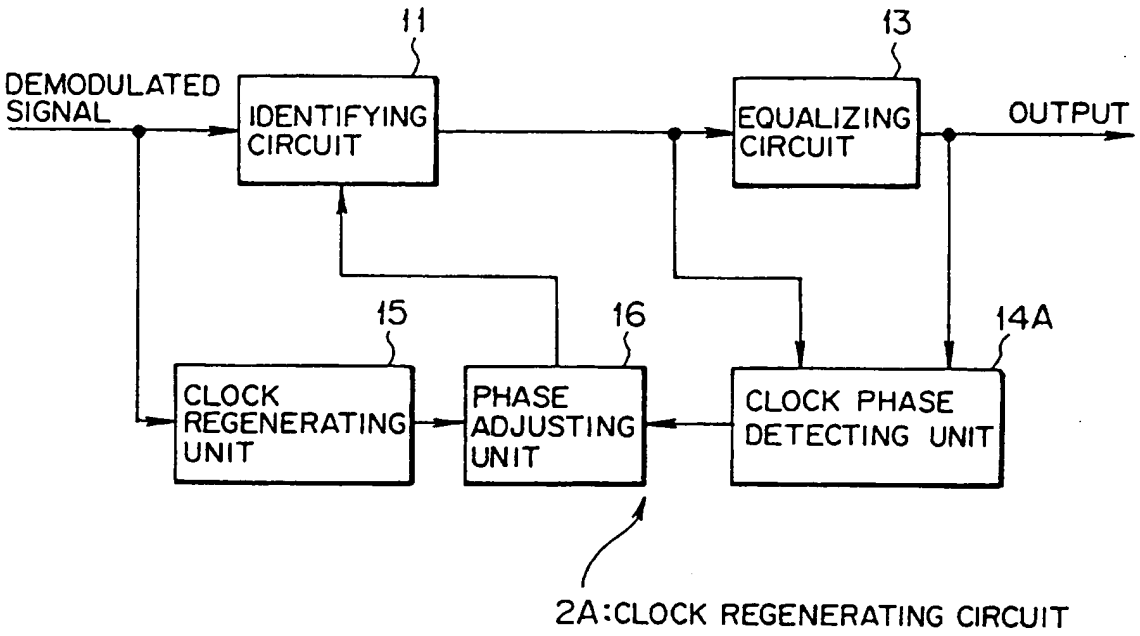

11
13
DEMODULATED SIGNAL
IDENTIFYING CIRCUIT
EQUALIZING CIRCUIT
OUTPUT
15
16
14A
CLOCK REGENERATING UNIT
PHASE ADJUSTING UNIT
CLOCK PHASE DETECTING UNIT
2A:CLOCK REGENERATING CIRCUIT

FIG. 3

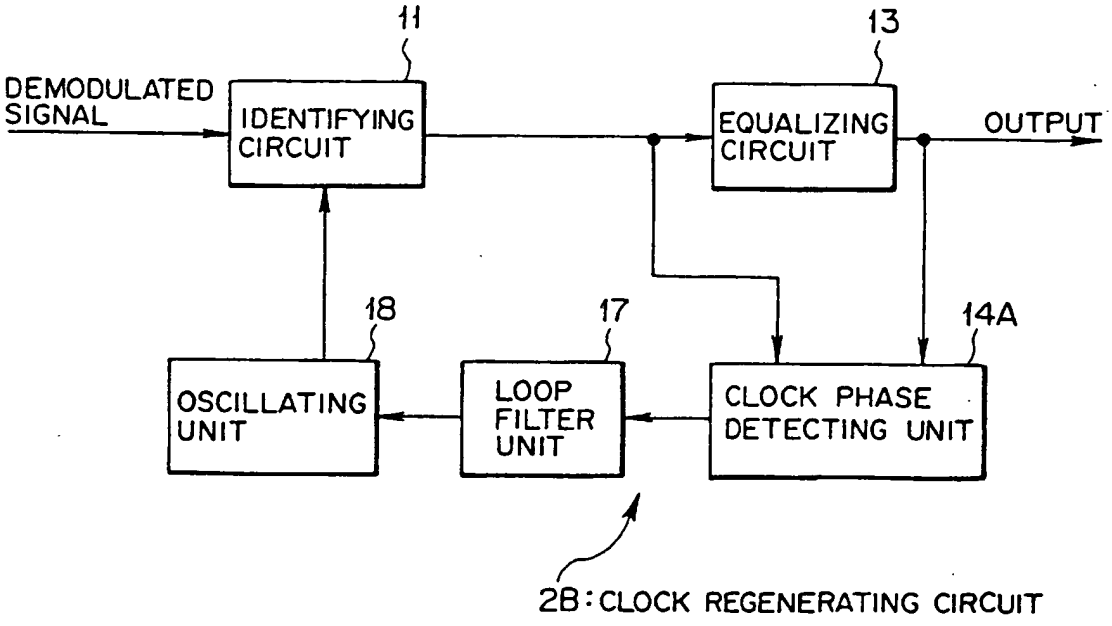

11
13
DEMODULATED SIGNAL
IDENTIFYING CIRCUIT
EQUALIZING CIRCUIT
OUTPUT
18
17
14A
OSCILLATING UNIT
LOOP FILTER UNIT
CLOCK PHASE DETECTING UNIT
28: CLOCK REGENERATING CIRCUIT

FIG.4

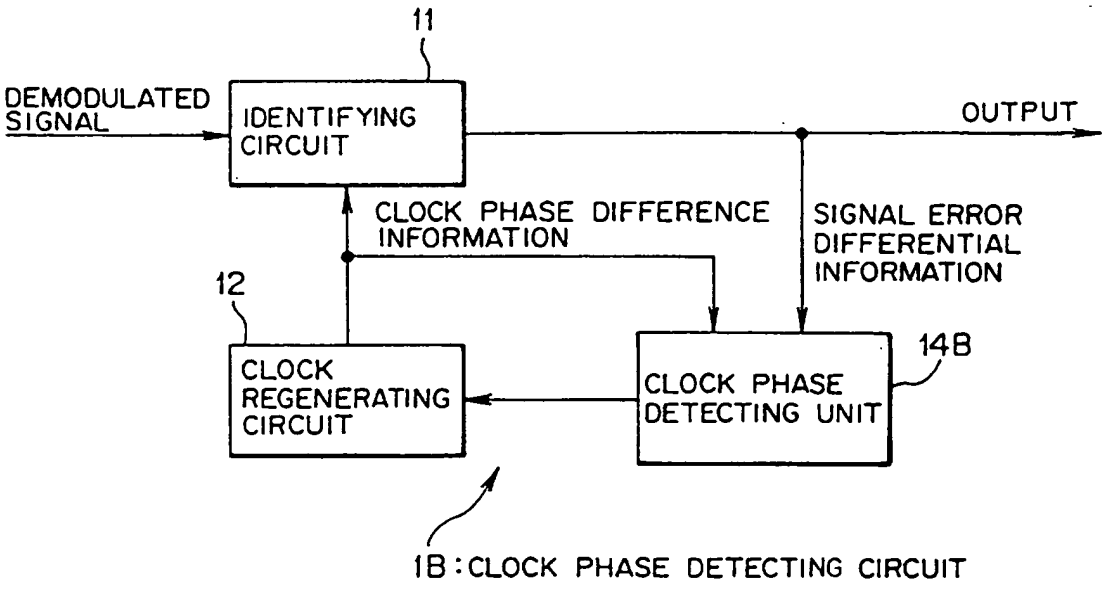

11
DEMODULATED SIGNAL
IDENTIFYING CIRCUIT
OUTPUT
CLOCK PHASE DIFFERENCE INFORMATION
SIGNAL ERROR DIFFERENTIAL INFORMATION
12
CLOCK REGENERATING CIRCUIT
14B
CLOCK PHASE DETECTING UNIT
1B : CLOCK PHASE DETECTING CIRCUIT

FIG.5

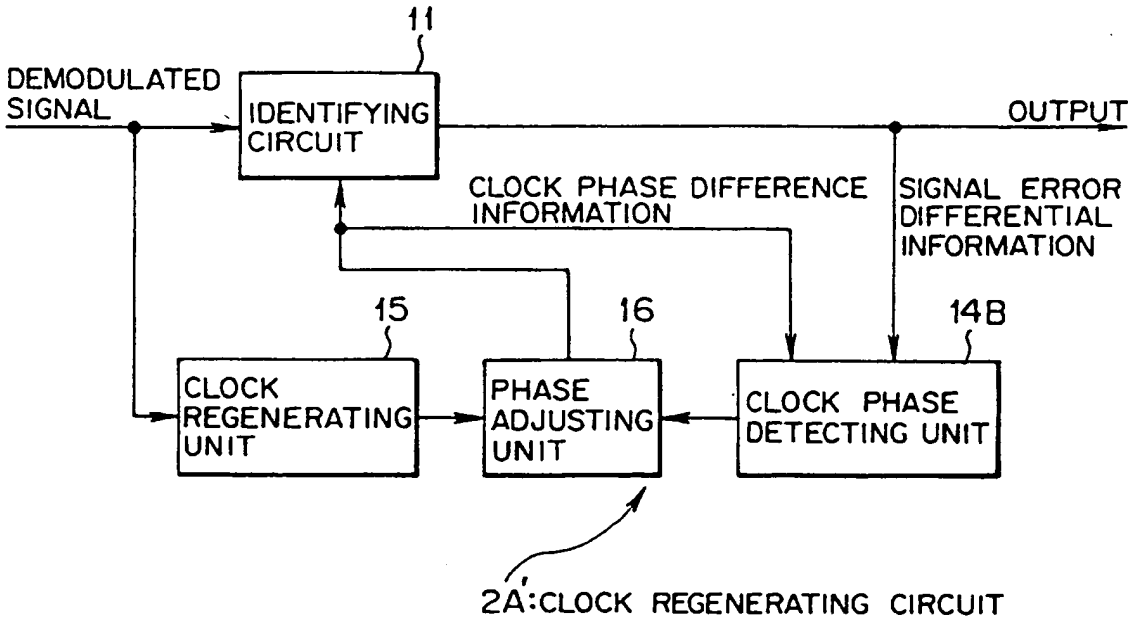
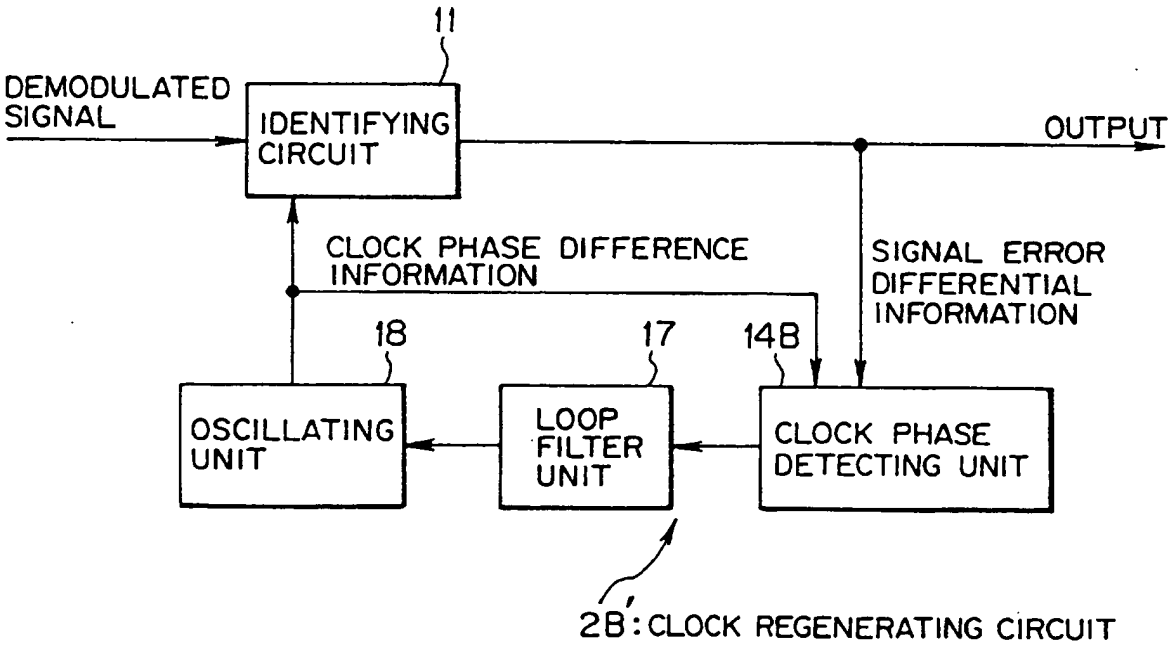

11
DEMODULATED SIGNAL
IDENTIFYING CIRCUIT
OUTPUT
CLOCK PHASE DIFFERENCE INFORMATION
SIGNAL ERROR DIFFERENTIAL INFORMATION
15
16
14B
CLOCK REGENERATING UNIT
PHASE ADJUSTING UNIT
CLOCK PHASE DETECTING UNIT
2A':CLOCK REGENERATING CIRCUIT

FIG.6


11
DEMODULATED SIGNAL
IDENTIFYING CIRCUIT
OUTPUT
CLOCK PHASE DIFFERENCE INFORMATION
SIGNAL ERROR DIFFERENTIAL INFORMATION
18
17
14B
OSCILLATING UNIT
LOOP FILTER UNIT
CLOCK PHASE DETECTING UNIT
2B': CLOCK REGENERATING CIRCUIT

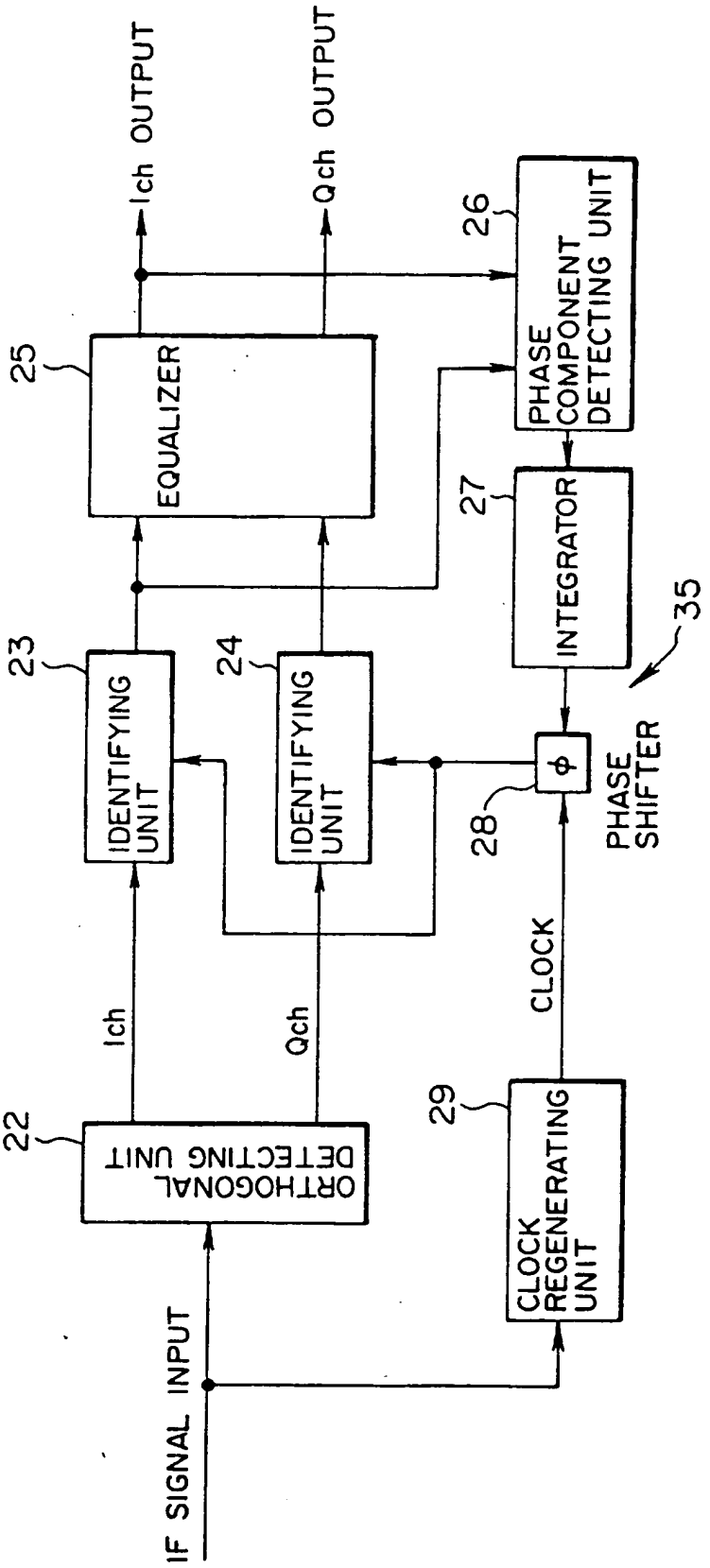


FIG.7

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FIG.8

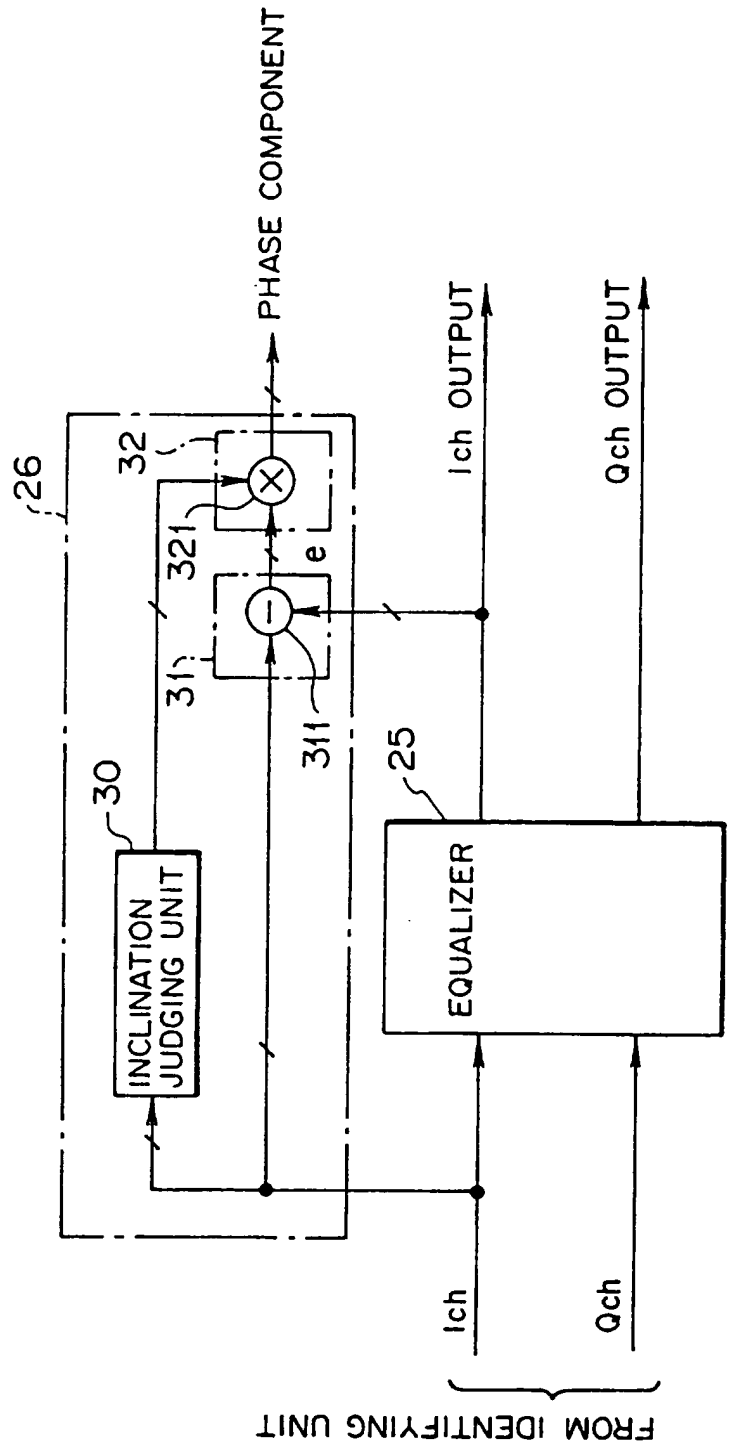
PHASE COMPONENT
Ich OUTPUT
Qch OUTPUT
26
32
321
e
31
311
30
25
INCLINATION JUDGING UNIT
EQUALIZER
Ich
Qch
FROM IDENTIFYING UNIT

FIG. 9

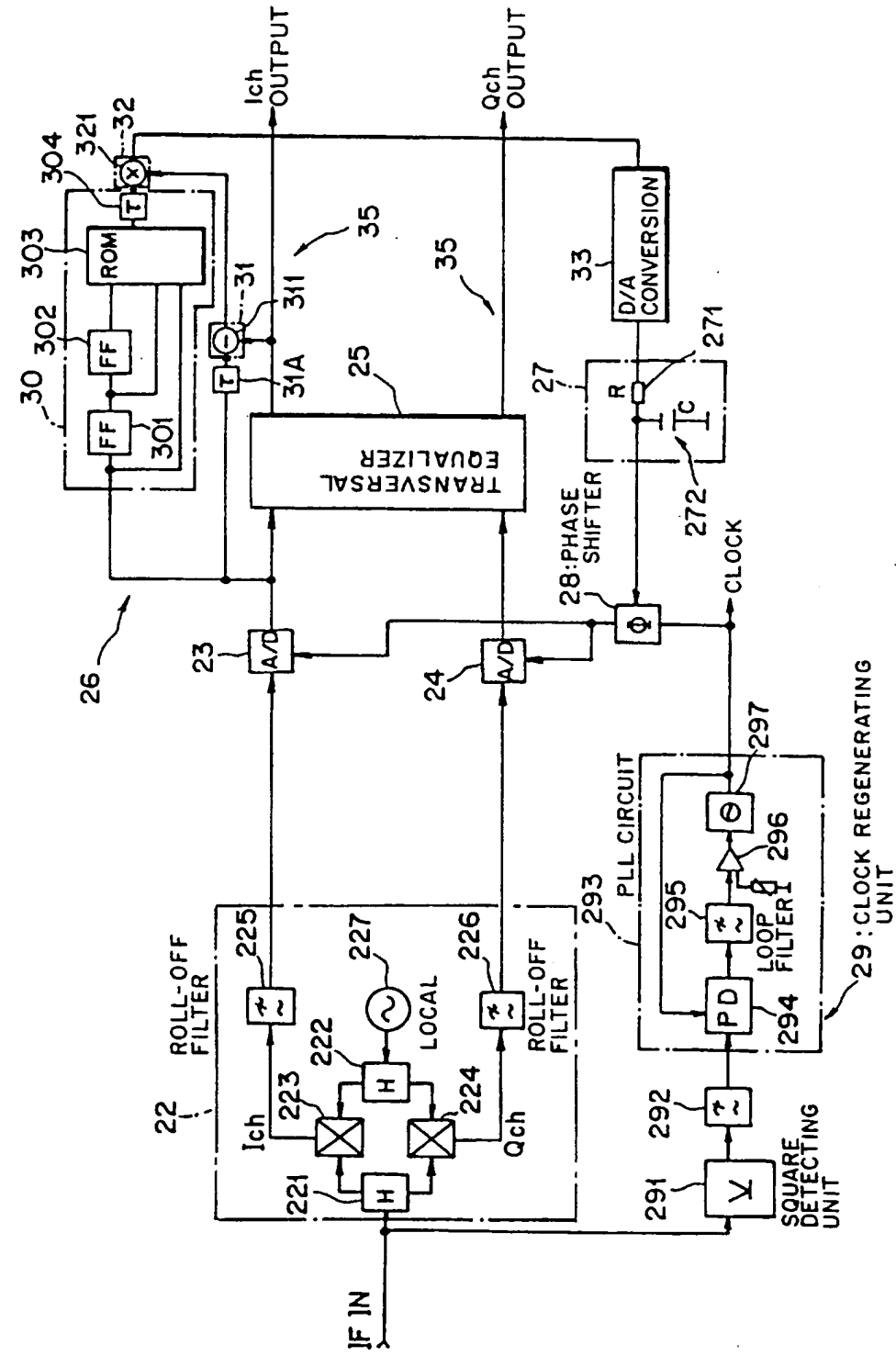
Ich OUTPUT
Qch OUTPUT
TRANSVERSAL EQUALIZER
D/A CONVERSION
ROM
FF
FF
A/D
A/D
28:PHASE SHIFTER
CLOCK
ROLL-OFF FILTER
ROLL-OFF FILTER
LOCAL
PLL CIRCUIT
LOOP FILTER
PD
29:CLOCK REGENERATING UNIT
SQUARE DETECTING UNIT
IF IN
Ich
Qch

FIG. 10

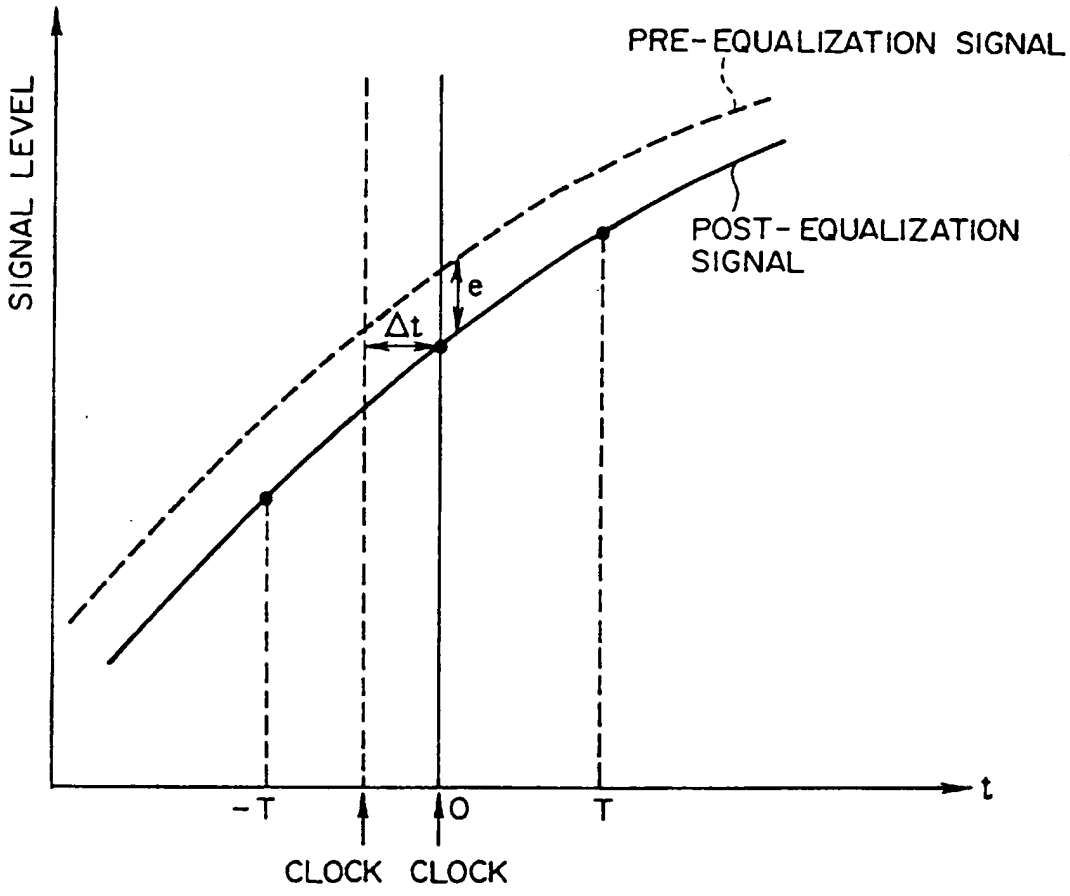
PRE-EQUALIZATION SIGNAL
POST-EQUALIZATION SIGNAL
SIGNAL LEVEL
e
Δt
-T
0
T
t
CLOCK
CLOCK

FIG. 11

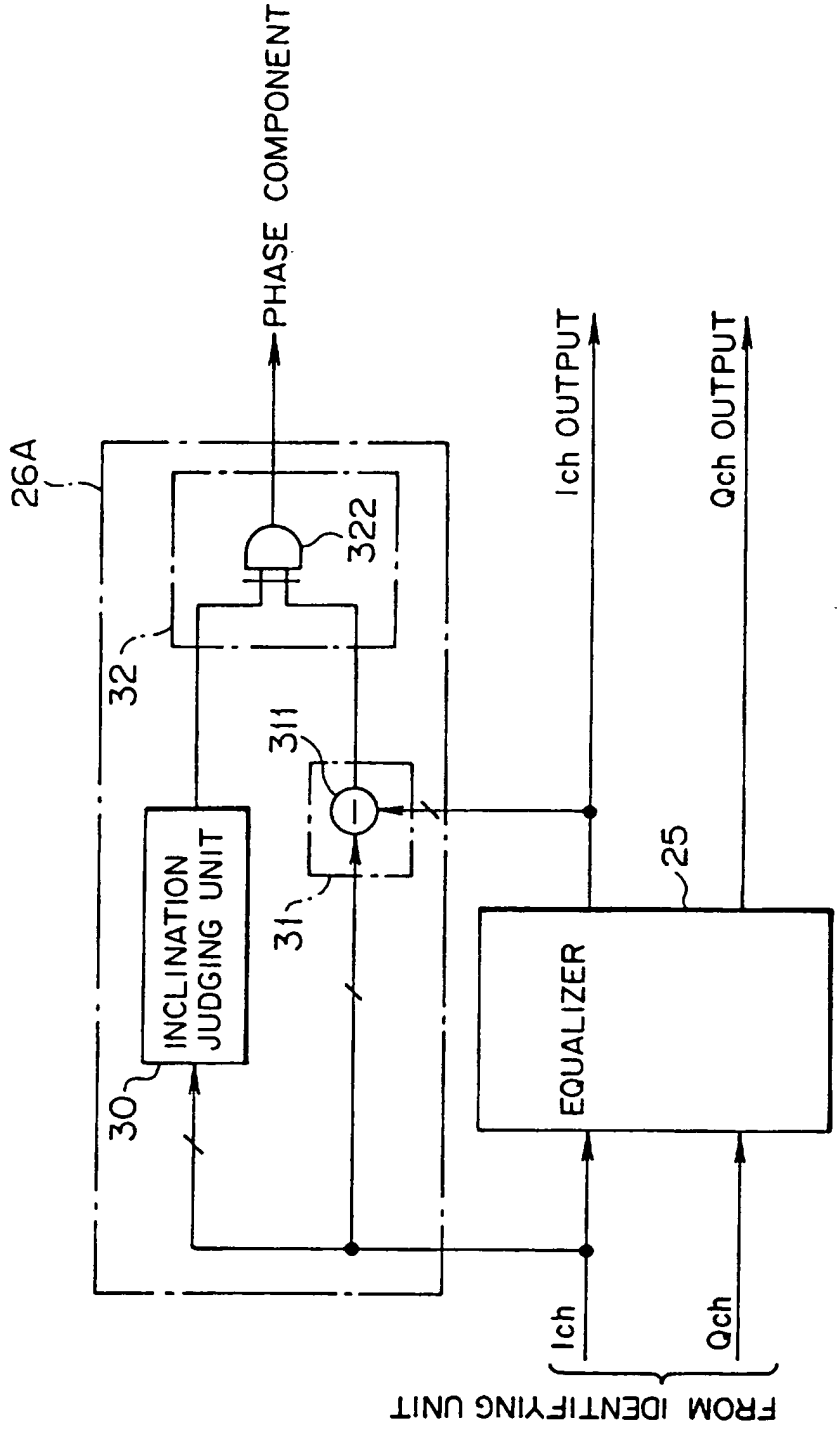
PHASE COMPONENT
Ich OUTPUT
Qch OUTPUT
26A
322
32
311
31
INCLINATION JUDGING UNIT
30
25
EQUALIZER
Ich
Qch
FROM IDENTIFYING UNIT

FIG. 12

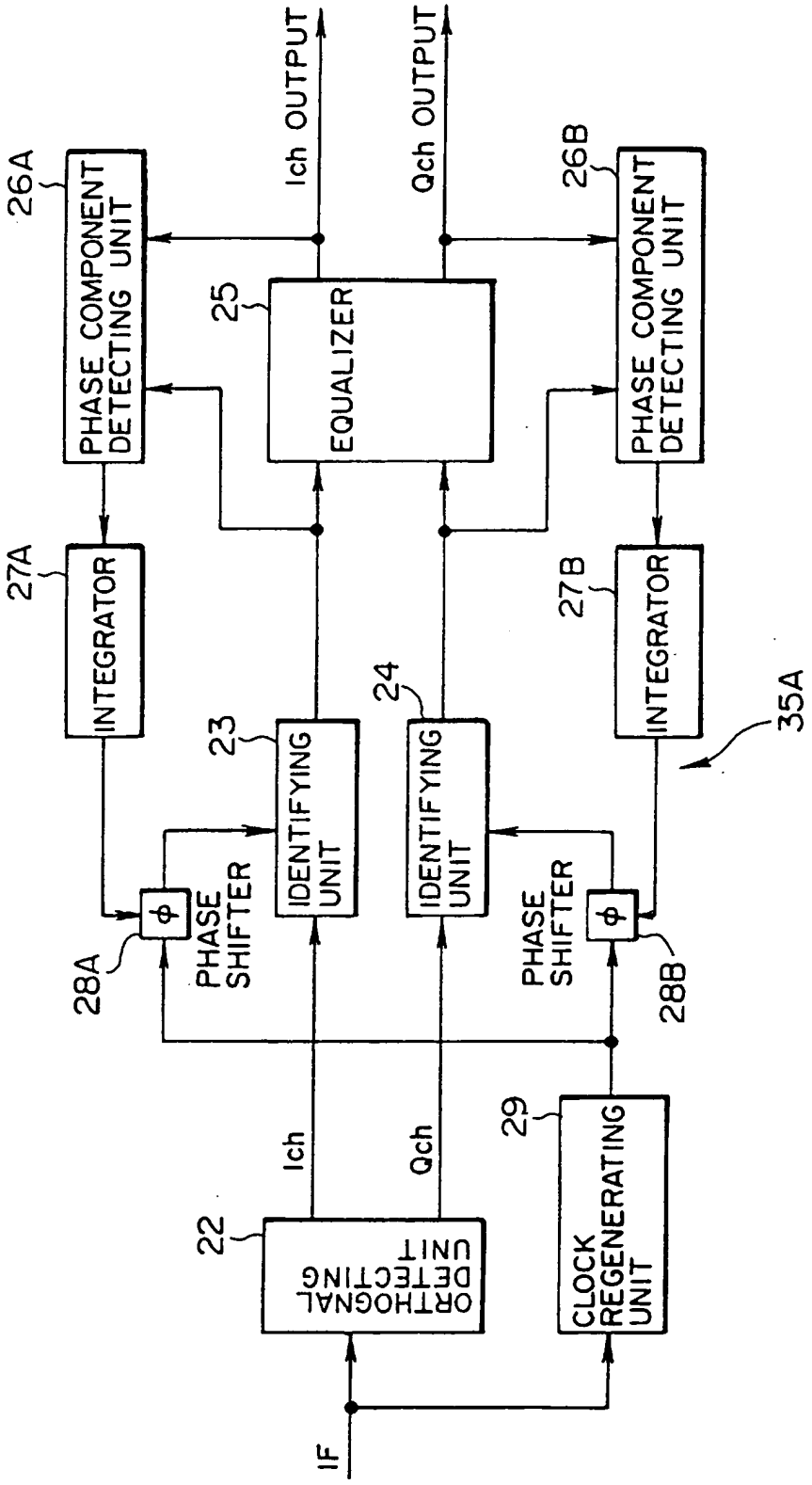
Ich OUTPUT
Qch OUTPUT
26A
PHASE COMPONENT DETECTING UNIT
25
EQUALIZER
26B
PHASE COMPONENT DETECTING UNIT
27A
INTEGRATOR
27B
INTEGRATOR
24
23
IDENTIFYING UNIT
IDENTIFYING UNIT
35A
28A
PHASE SHIFTER
PHASE SHIFTER
28B
Ich
Qch
29
CLOCK REGENERATING UNIT
22
ORTHOGNAL DETECTING UNIT
IF

FIG. 13

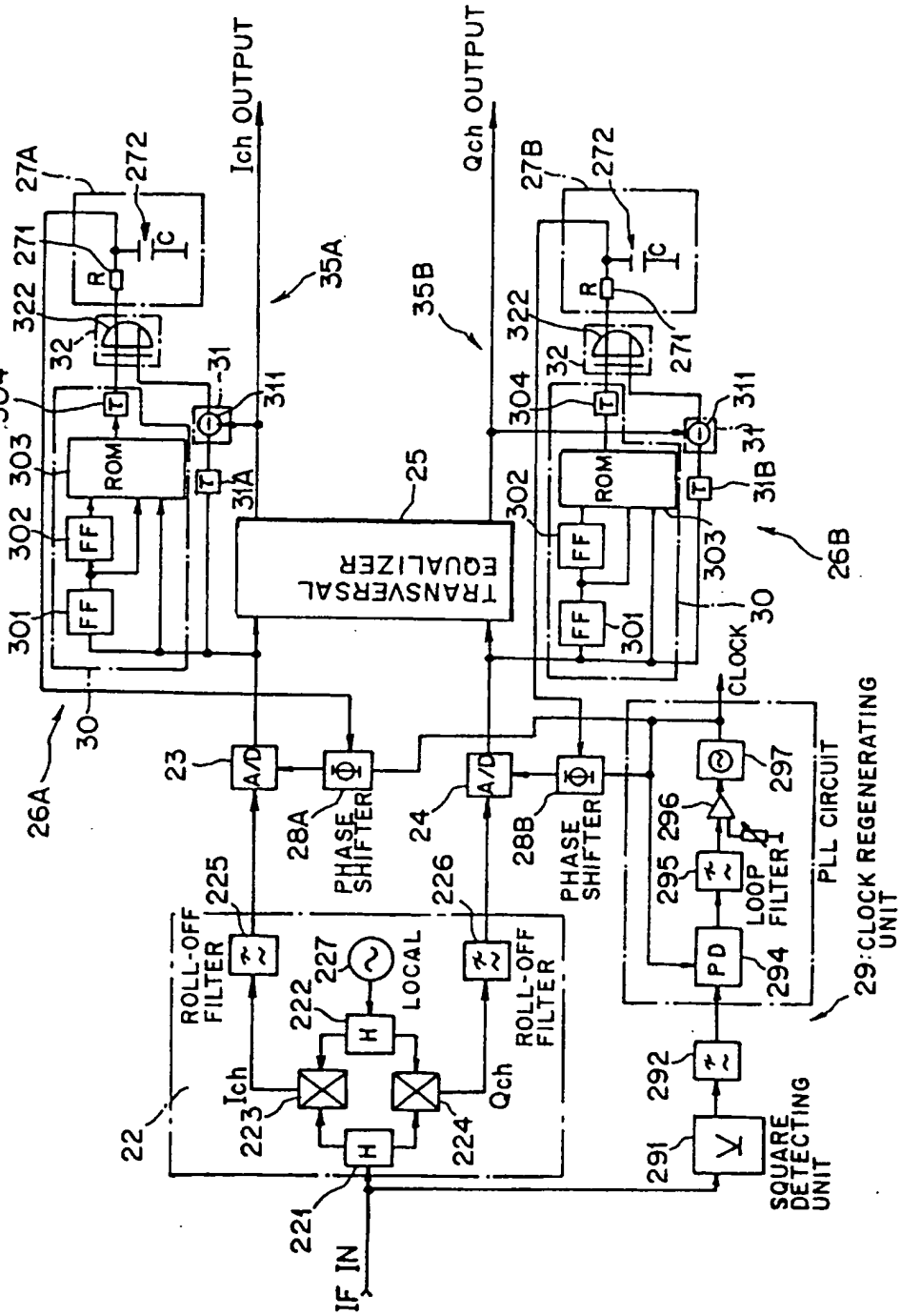
Ich OUTPUT
Qch OUTPUT
TRANSVERSAL EQUALIZER
ROM
FF
PHASE SHIFTER
ROLL-OFF FILTER
LOCAL
LOOP FILTER
PLL CIRCUIT
CLOCK REGENERATING UNIT
SQUARE DETECTING UNIT
IF IN
CLOCK
Ich
Qch

FIG. 14

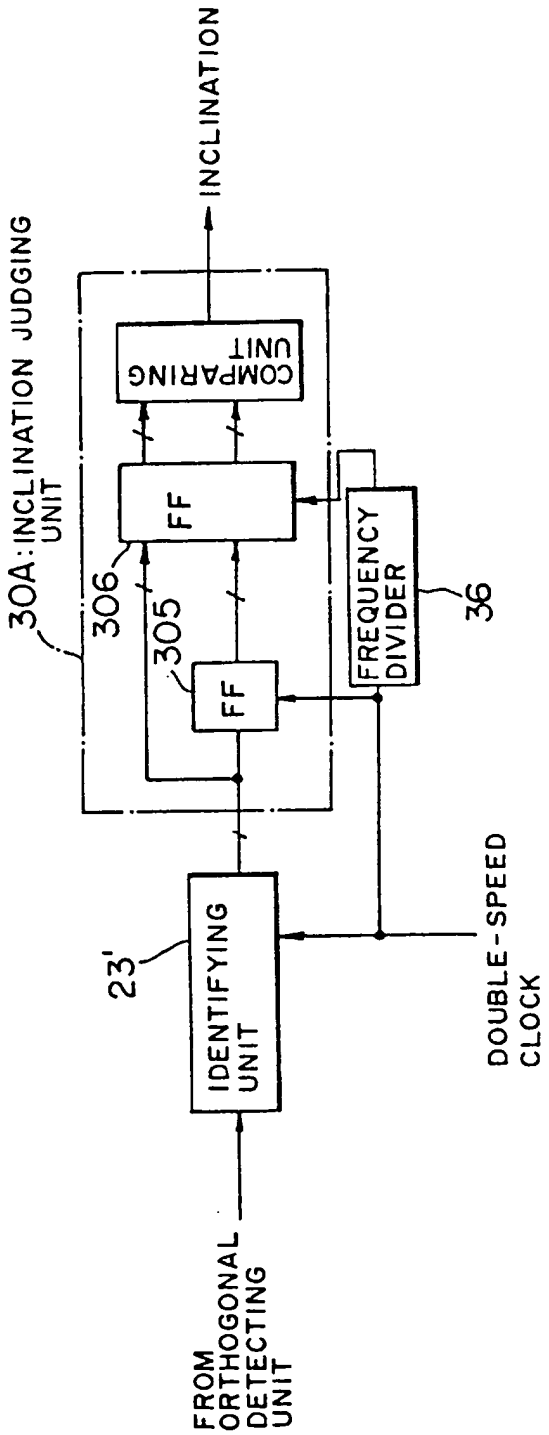
INCLINATION
30A: INCLINATION JUDGING UNIT
COMPARING UNIT
FF
306
305
FF
FREQUENCY DIVIDER
36
23'
IDENTIFYING UNIT
DOUBLE-SPEED CLOCK
FROM ORTHOGONAL DETECTING UNIT

FIG. 15

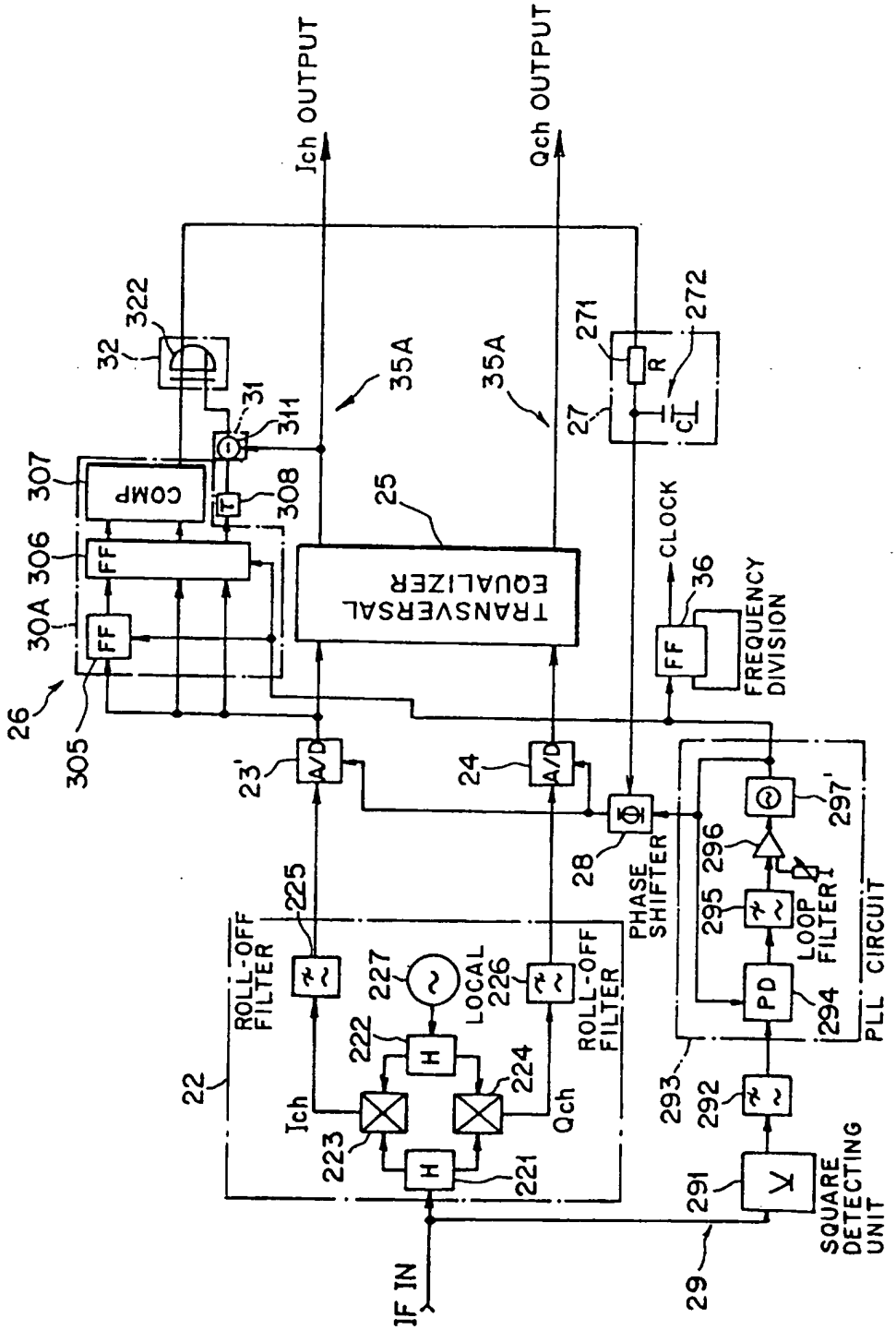
Ich OUTPUT
Qch OUTPUT
TRANSVERSAL EQUALIZER
COMP
FF
A/D
CLOCK
FREQUENCY DIVISION
PHASE SHIFTER
ROLL-OFF FILTER
LOCAL
PD
LOOP FILTER
PLL CIRCUIT
SQUARE DETECTING UNIT
IF IN
Ich
Qch

FIG. 16

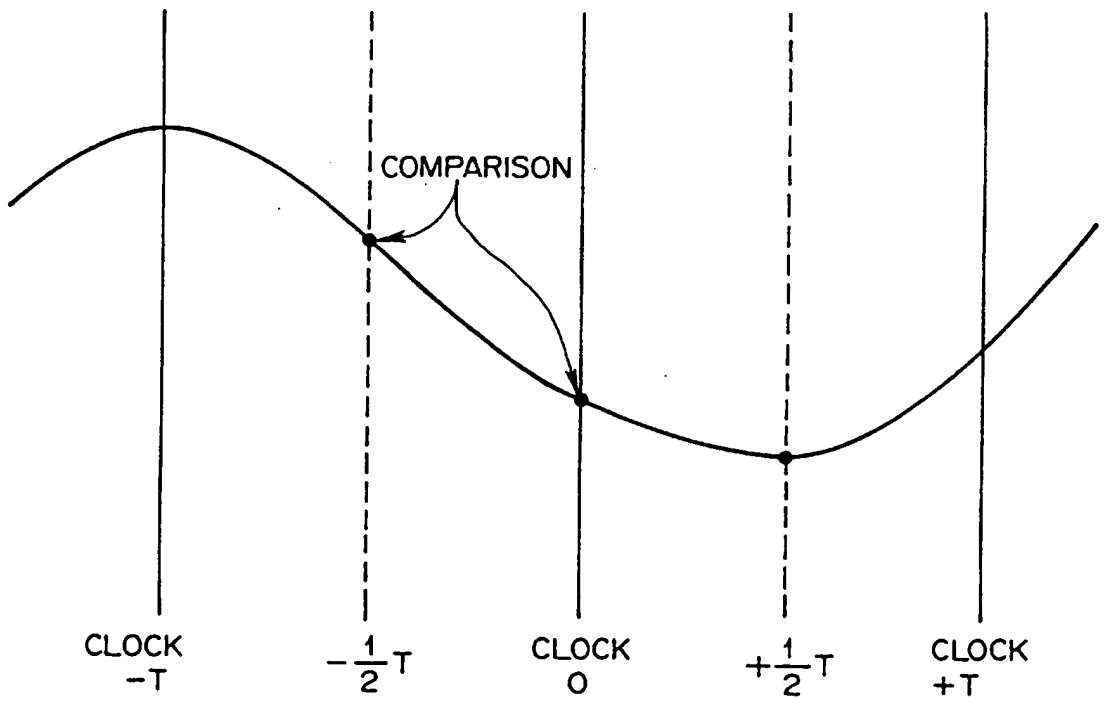

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FIG. 17

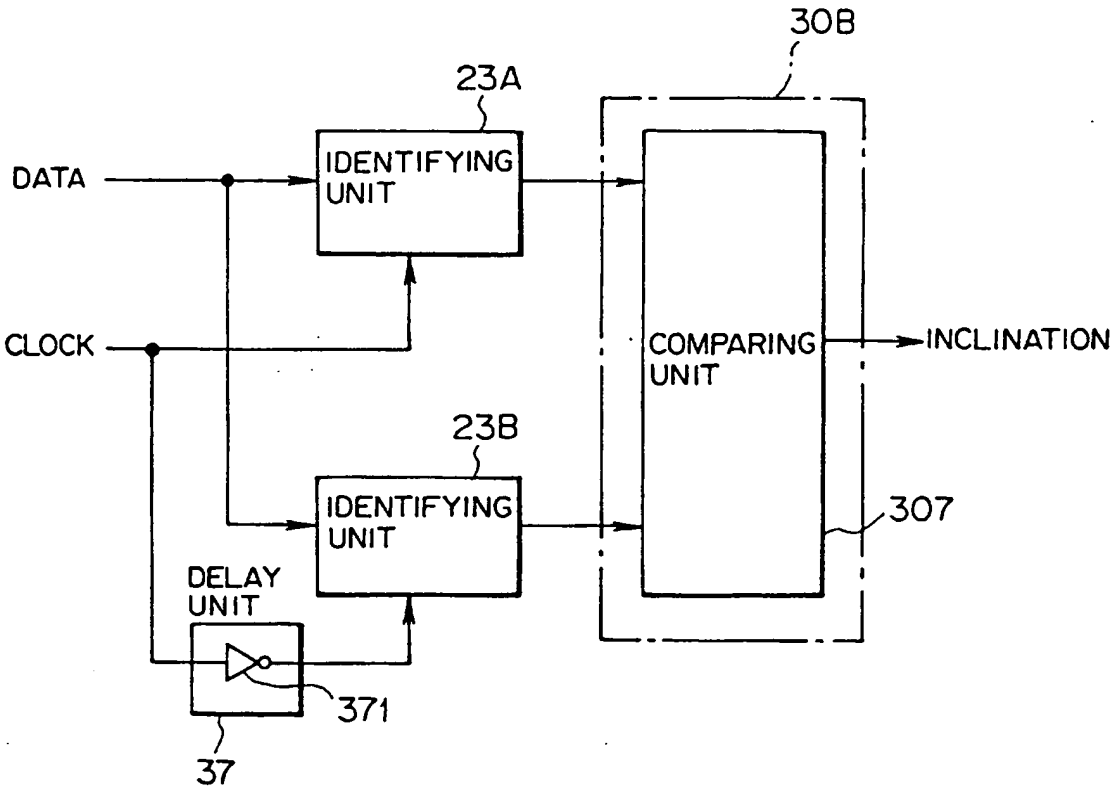
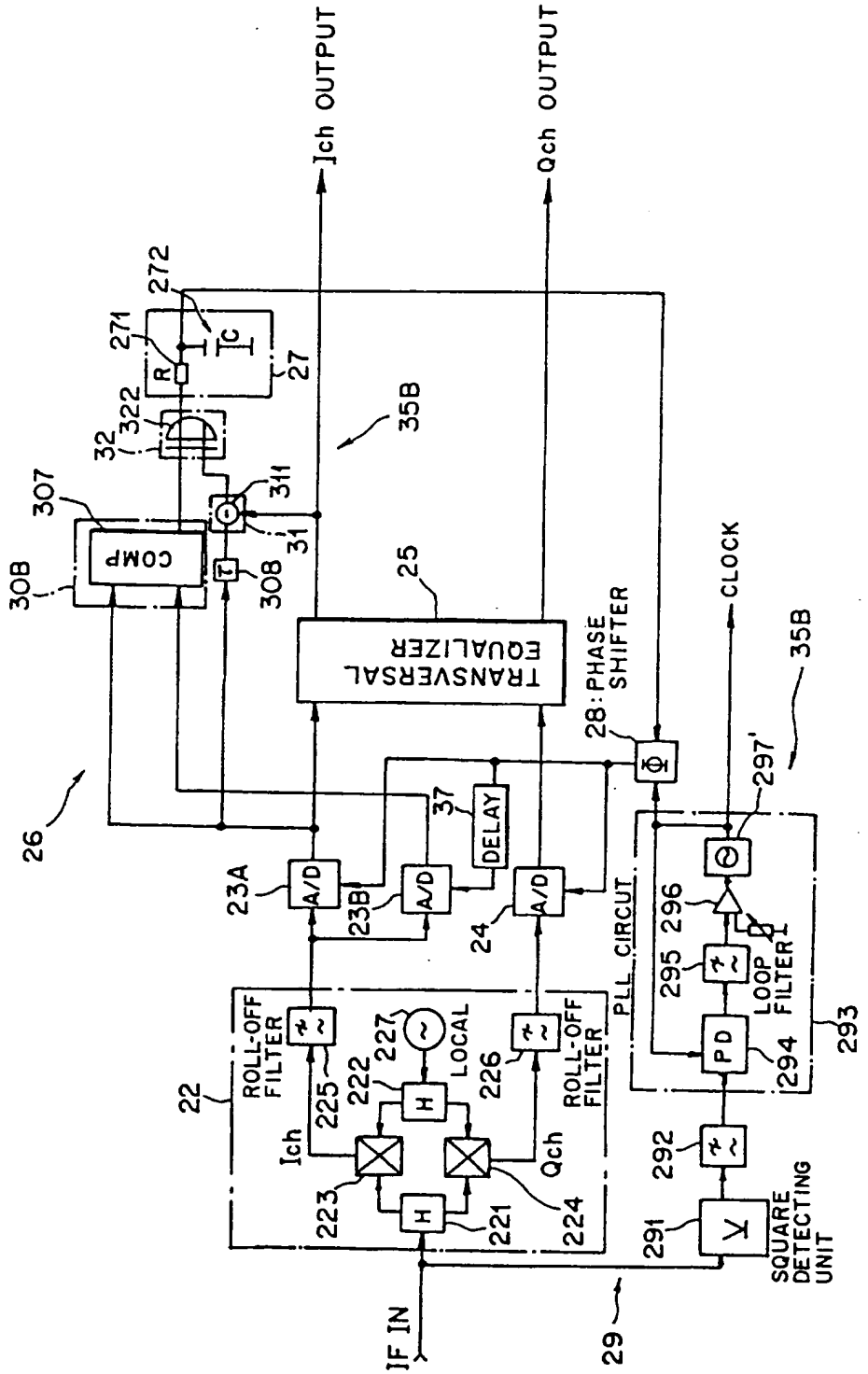

30B
23A
DATA
IDENTIFYING UNIT
CLOCK
COMPARING UNIT
INCLINATION
23B
IDENTIFYING UNIT
307
DELAY UNIT
371
37

FIG. 18


Ich OUTPUT
Qch OUTPUT
CLOCK
TRANSVERSAL EQUALIZER
25
COMP
307
308
311
31
32
322
271
272
27
35B
28: PHASE SHIFTER
DELAY
37
26
23A
23B
24
A/D
ROLL-OFF FILTER
LOCAL
227
222
225
226
221
223
224
Ich
Qch
H
22
PLL CIRCUIT
LOOP FILTER
295
296
297'
PD
294
293
292
291
SQUARE DETECTING UNIT
IF IN
29

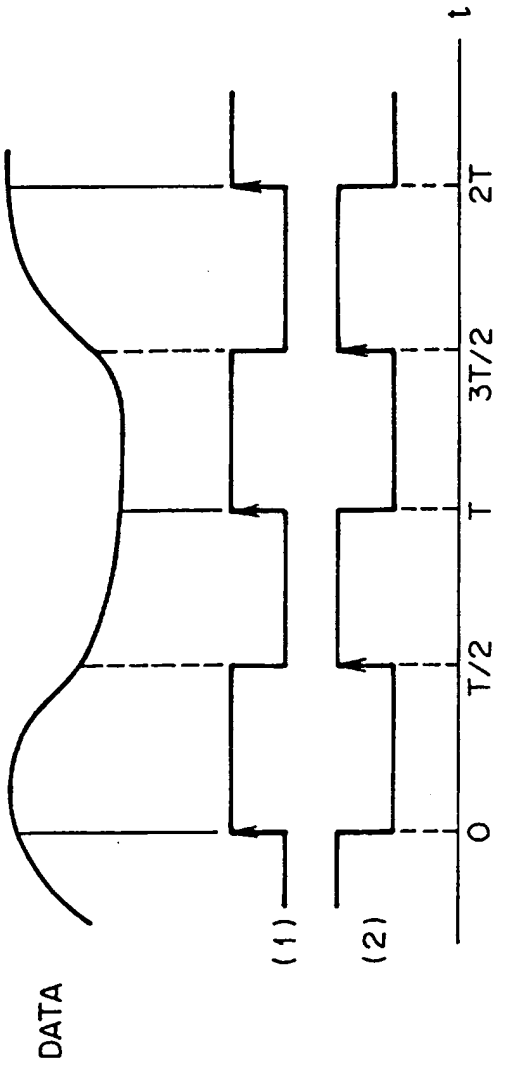


FIG. 19(a)

FIG. 19(b)

FIG. 19(c)

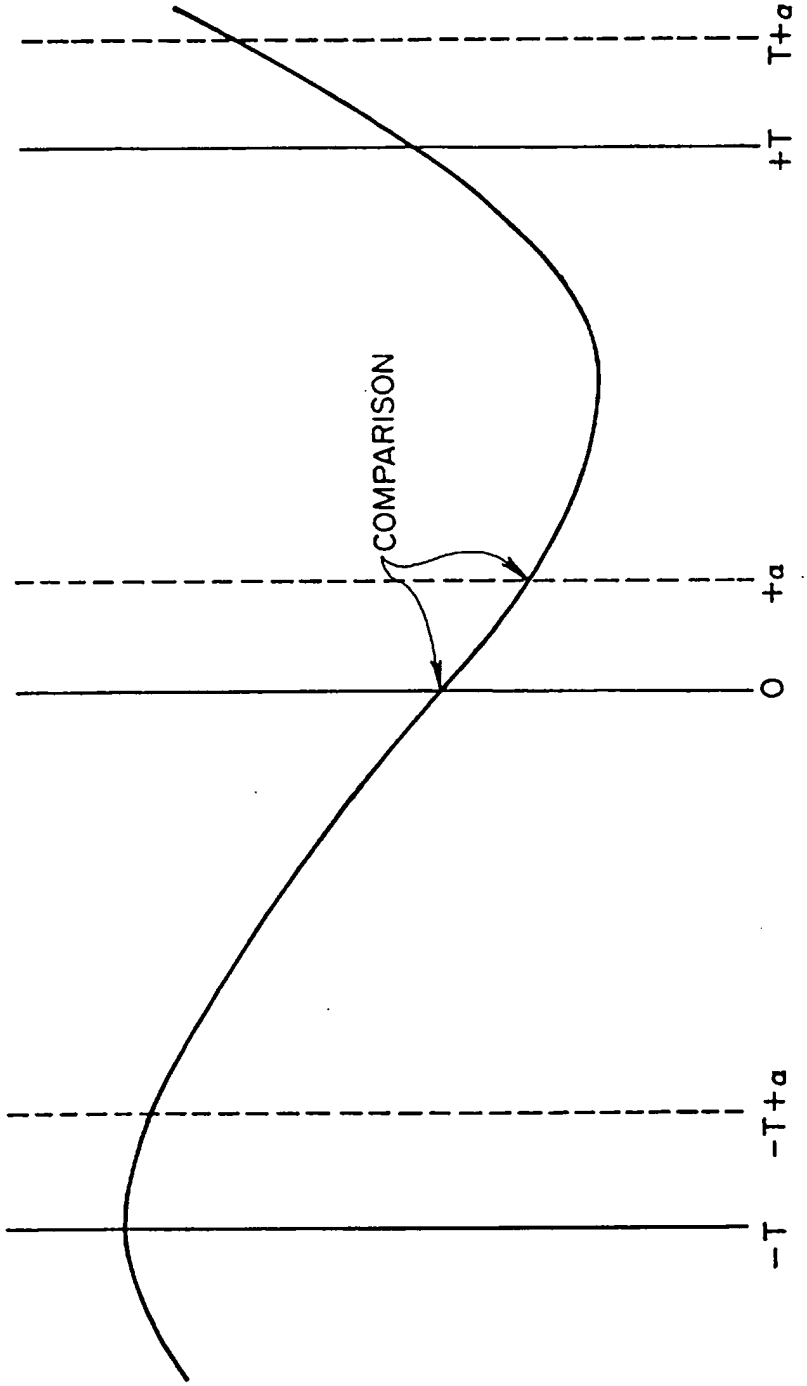


FIG. 20

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FIG.21

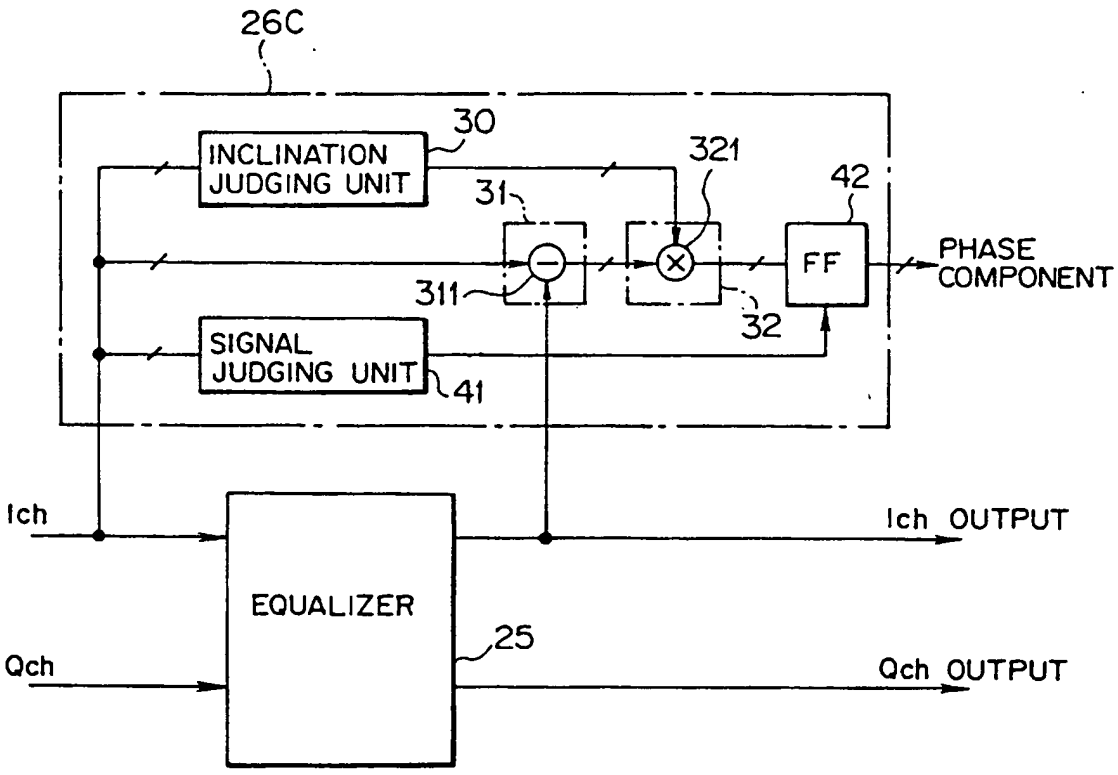

26C
30
INCLINATION JUDGING UNIT
321
42
31
FF
PHASE COMPONENT
311
32
SIGNAL JUDGING UNIT
41
Ich
Ich OUTPUT
EQUALIZER
25
Qch
Qch OUTPUT

FIG. 22

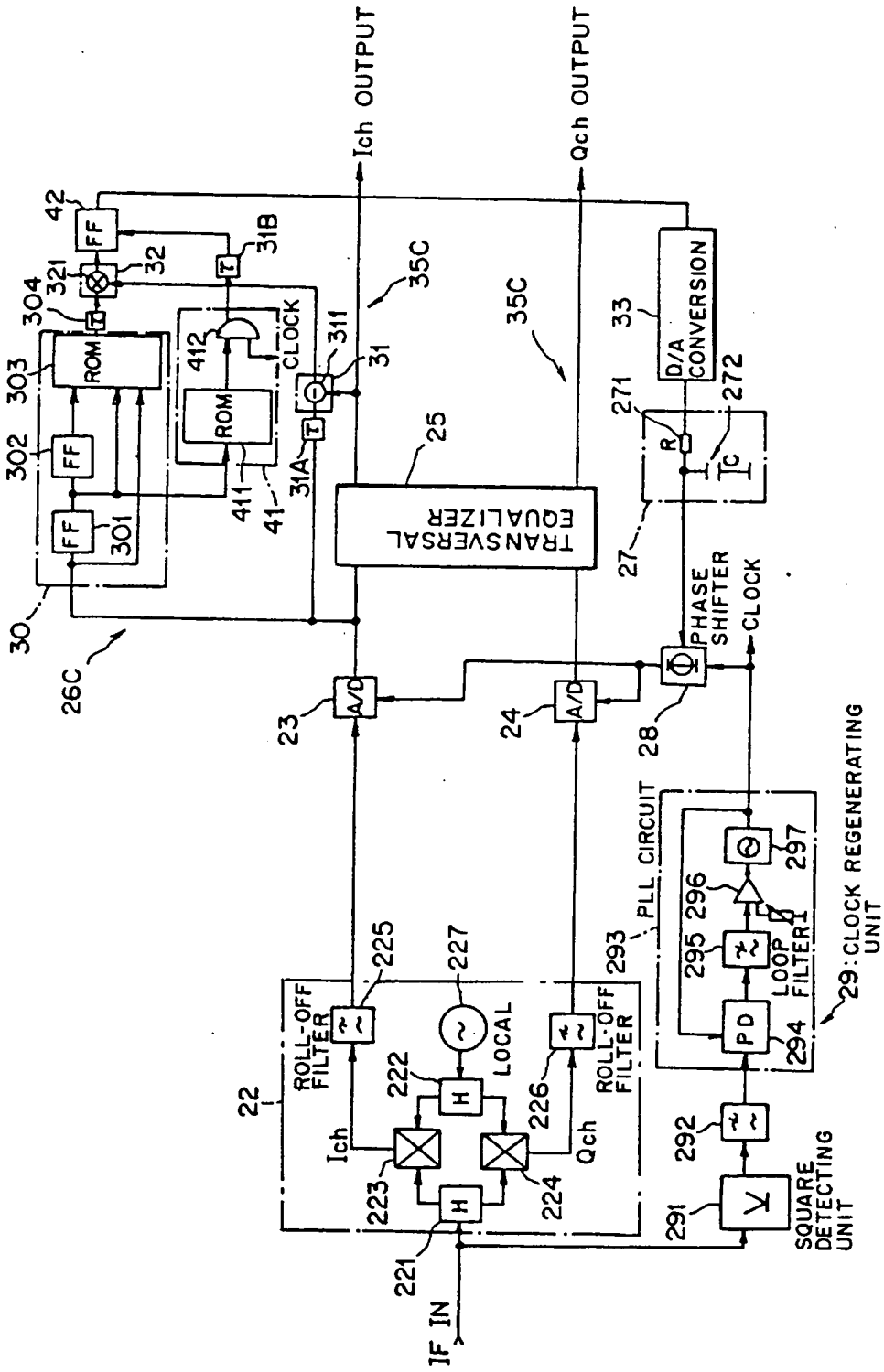

Ich OUTPUT
Qch OUTPUT
TRANSVERSAL EQUALIZER
D/A CONVERSION
PHASE SHIFTER
CLOCK
ROM
FF
A/D
ROLL-OFF FILTER
LOCAL
PLL CIRCUIT
LOOP FILTER
PD
SQUARE DETECTING UNIT
29: CLOCK REGENERATING UNIT
IF IN
Ich
Qch

FIG. 23

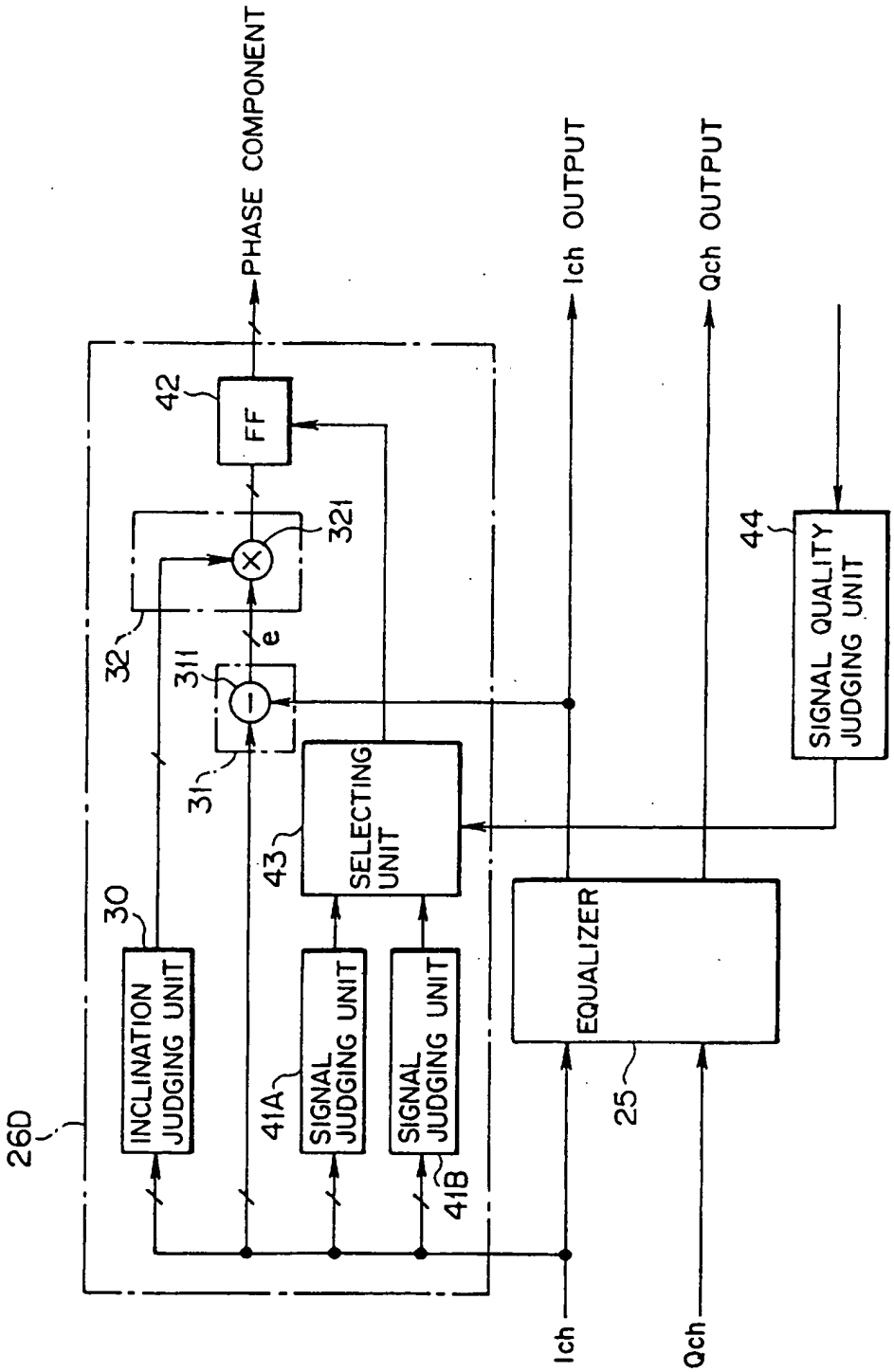

PHASE COMPONENT
Ich OUTPUT
Qch OUTPUT
42
FF
321
32
311
e
31
43
SELECTING UNIT
44
SIGNAL QUALITY JUDGING UNIT
30
INCLINATION JUDGING UNIT
41A
SIGNAL JUDGING UNIT
SIGNAL JUDGING UNIT
41B
EQUALIZER
25
26D
Ich
Qch

FIG. 24

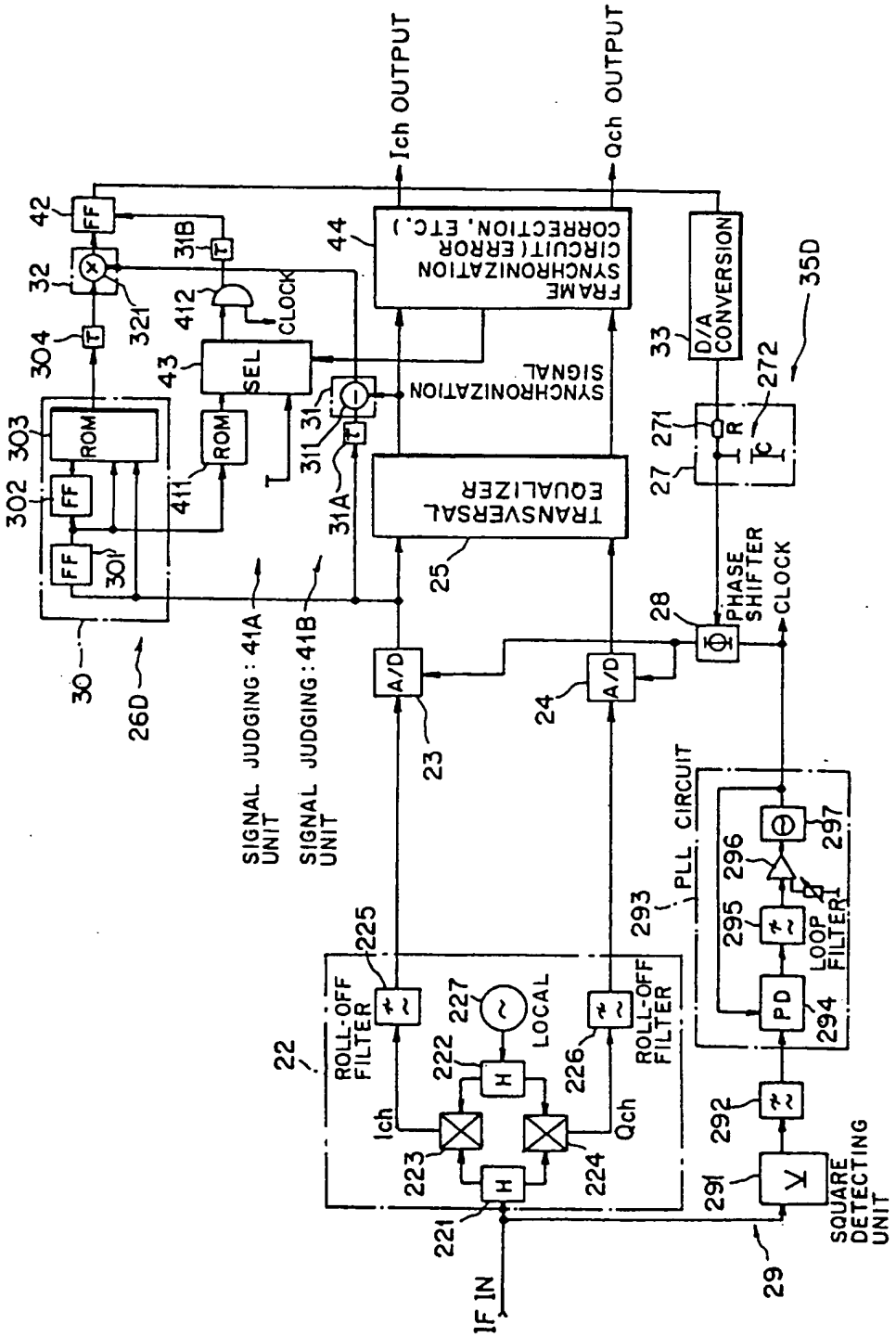
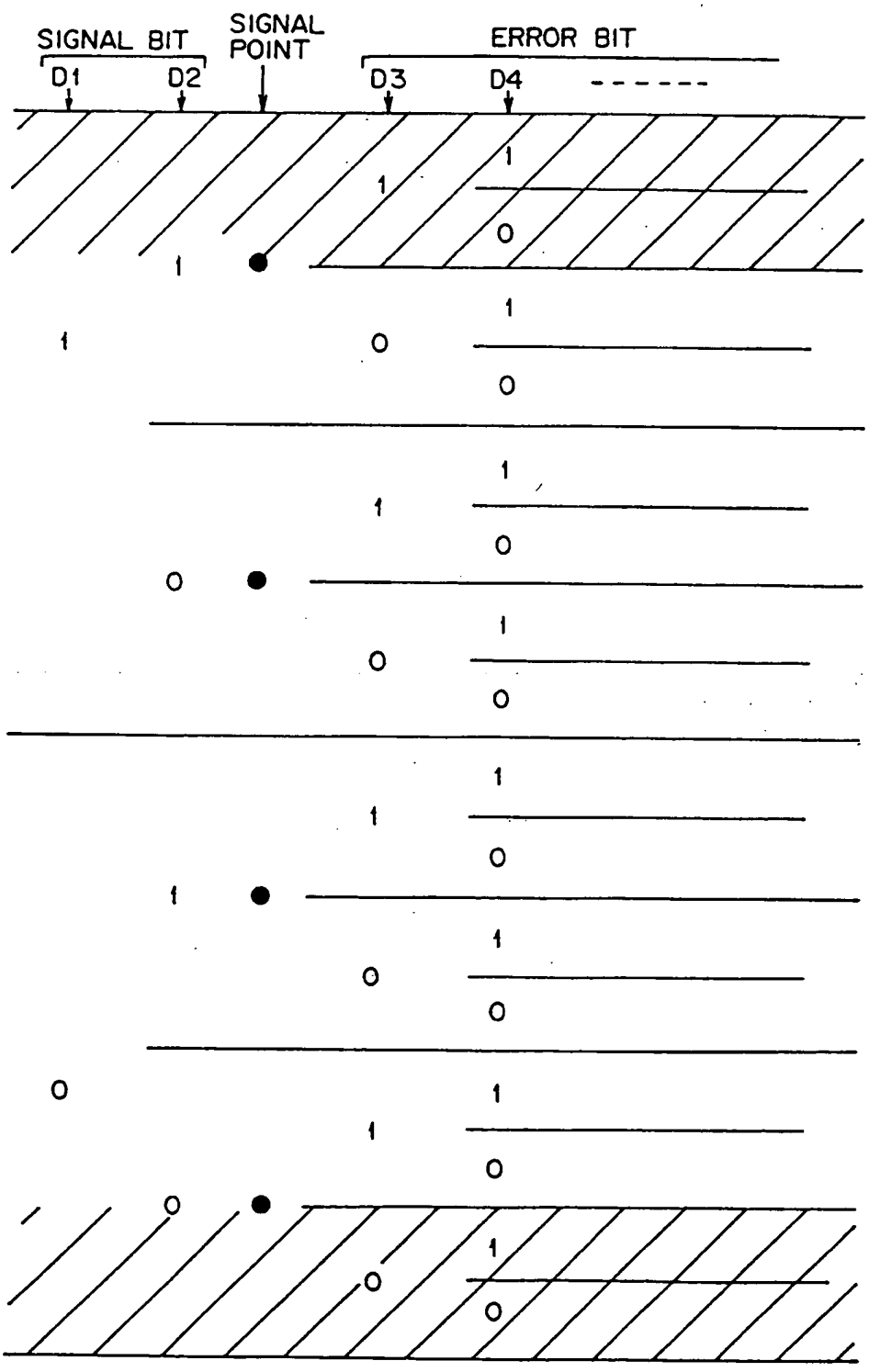

Ich OUTPUT
Qch OUTPUT
FRAME SYNCHRONIZATION CIRCUIT (ERROR CORRECTION, ETC.)
D/A CONVERSION
SYNCHRONIZATION SIGNAL
TRANSVERSAL EQUALIZER
PHASE SHIFTER
CLOCK
A/D
SIGNAL JUDGING UNIT
ROM
SEL
PLL CIRCUIT
LOOP FILTER
PD
ROLL-OFF FILTER
LOCAL
SQUARE DETECTING UNIT
IF IN
Ich
Qch
42
32
304
303
302
301
321
318
412
CLOCK
43
411
44
311
31
31A
33
35D
272
271
27
25
28
30
26D
41A
41B
23
24
225
227
222
226
223
224
221
22
293
297
296
295
294
292
291
29

FIG. 25



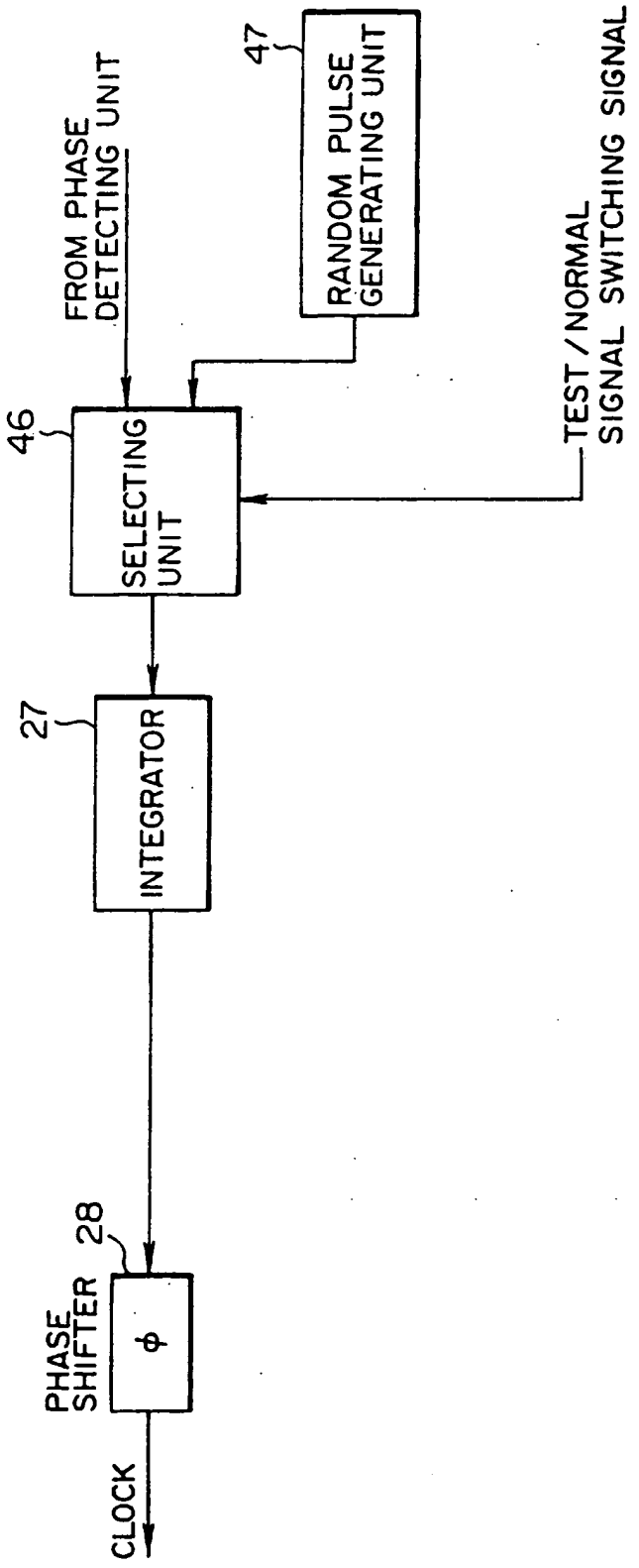


FIG. 26

EPSON EP-S22E/S50

FIG. 27

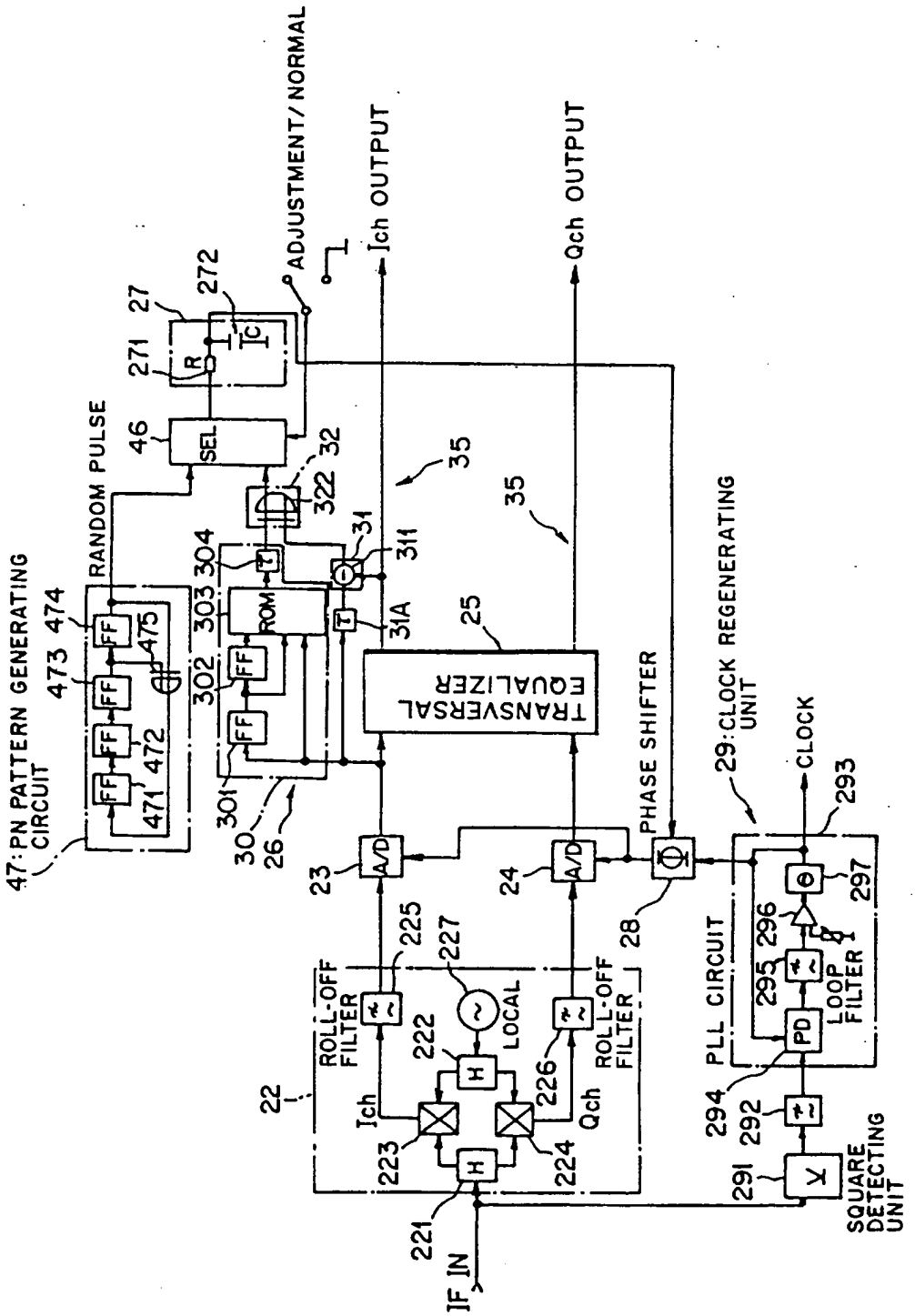

47: PN PATTERN GENERATING CIRCUIT
RANDOM PULSE
ADJUSTMENT/NORMAL
Ich OUTPUT
Qch OUTPUT
TRANSVERSAL EQUALIZER
PHASE SHIFTER
29: CLOCK REGENERATING UNIT
CLOCK
ROLL-OFF FILTER
LOCAL
PLL CIRCUIT
LOOP FILTER
SQUARE DETECTING UNIT
IF IN
ROM
SEL
A/D
PD

FIG. 28

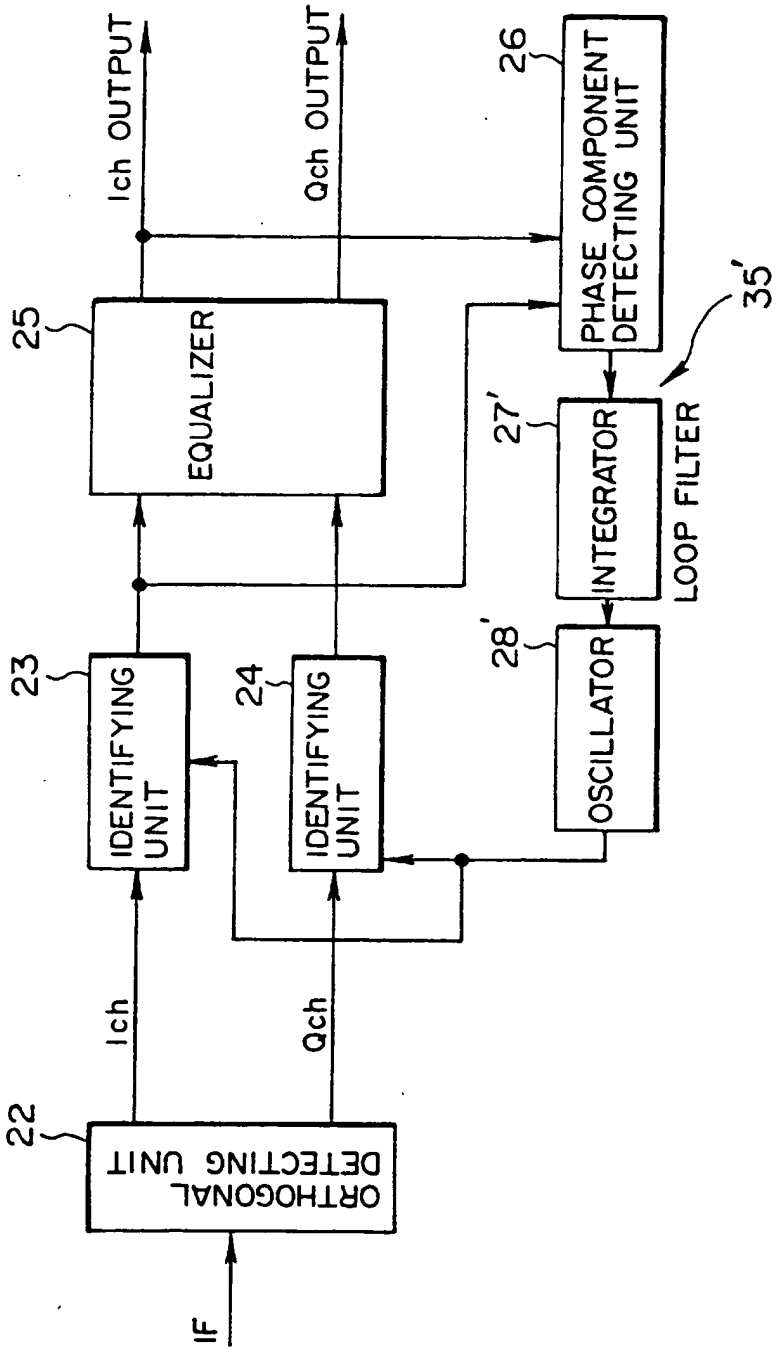

IF
ORTHOGONAL DETECTING UNIT
22
Ich
Qch
IDENTIFYING UNIT
23
IDENTIFYING UNIT
24
OSCILLATOR
28'
INTEGRATOR
27'
LOOP FILTER
35'
EQUALIZER
25
PHASE COMPONENT DETECTING UNIT
26
Ich OUTPUT
Qch OUTPUT

FIG. 29

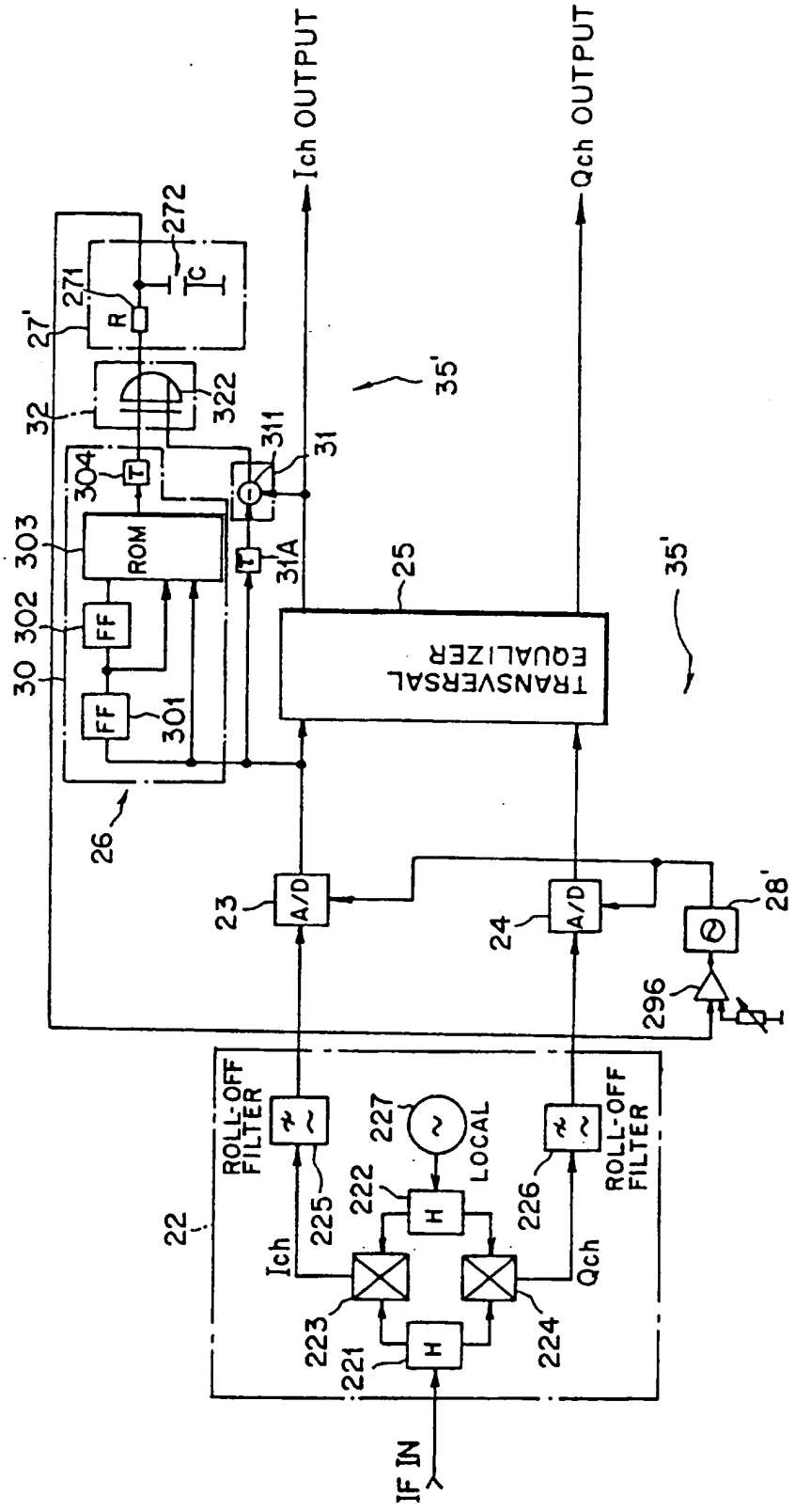

Ich OUTPUT
Qch OUTPUT
35'
272
271
27'
R
Tc
322
32
311
31
304
T
303
ROM
31A
25
TRANSVERSAL EQUALIZER
302
FF
30
301
26
23
A/D
24
28'
296
ROLL-OFF FILTER
227
LOCAL
222
225
226
22
Ich
Qch
223
221
224
IF IN

FIG. 30

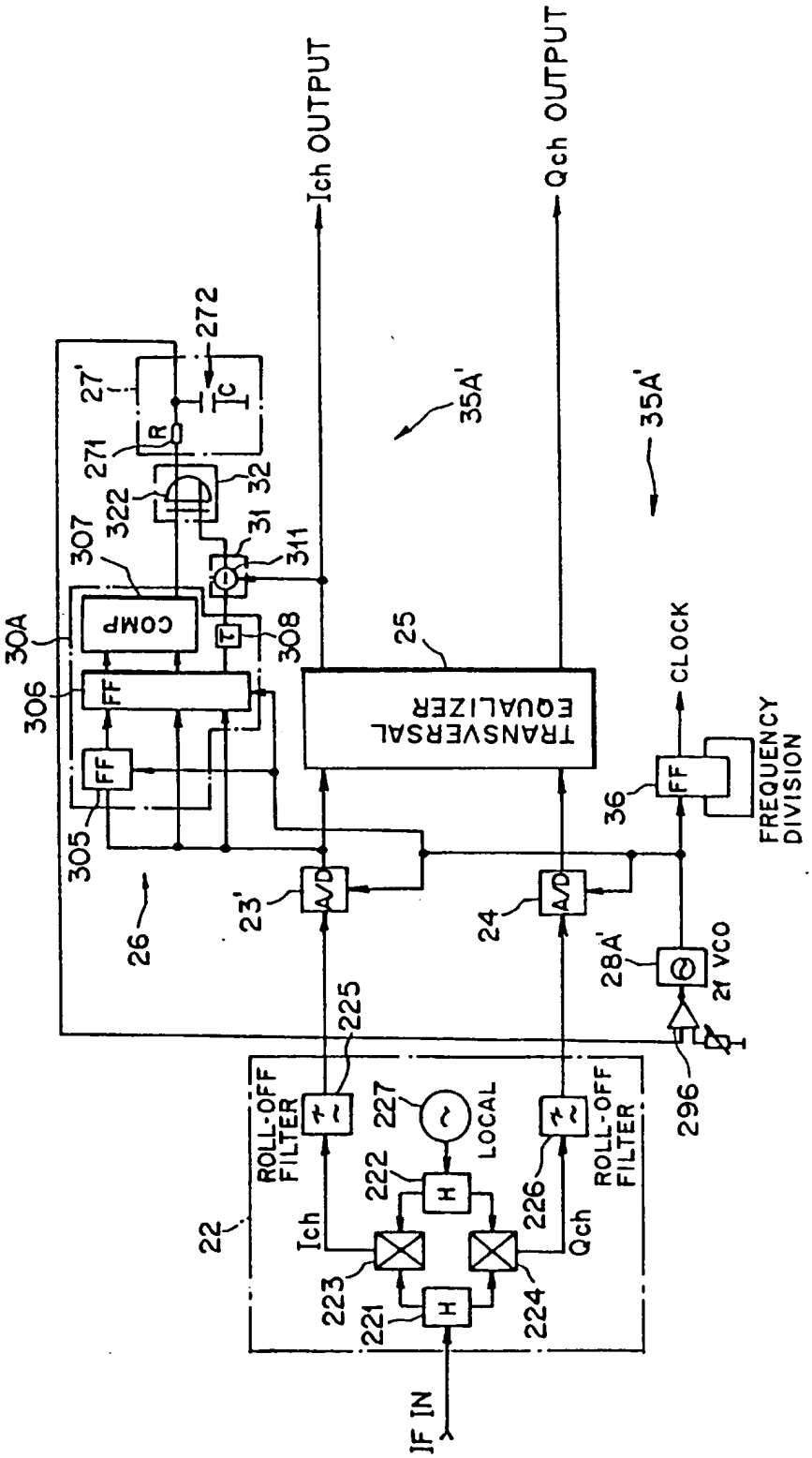

Ich OUTPUT
Qch OUTPUT
35A'
35A'
272
27'
271
322
307
311
32
31
30A
306
305
308
COMP
FF
FF
T
25
TRANSVERSAL EQUALIZER
CLOCK
FREQUENCY DIVISION
36
FF
26
23'
24
A/D
A/D
28A'
21 VCO
225
227
LOCAL
ROLL-OFF FILTER
ROLL-OFF FILTER
222
226
Ich
Qch
22
223
224
221
H
H
IF IN
296

FIG. 31

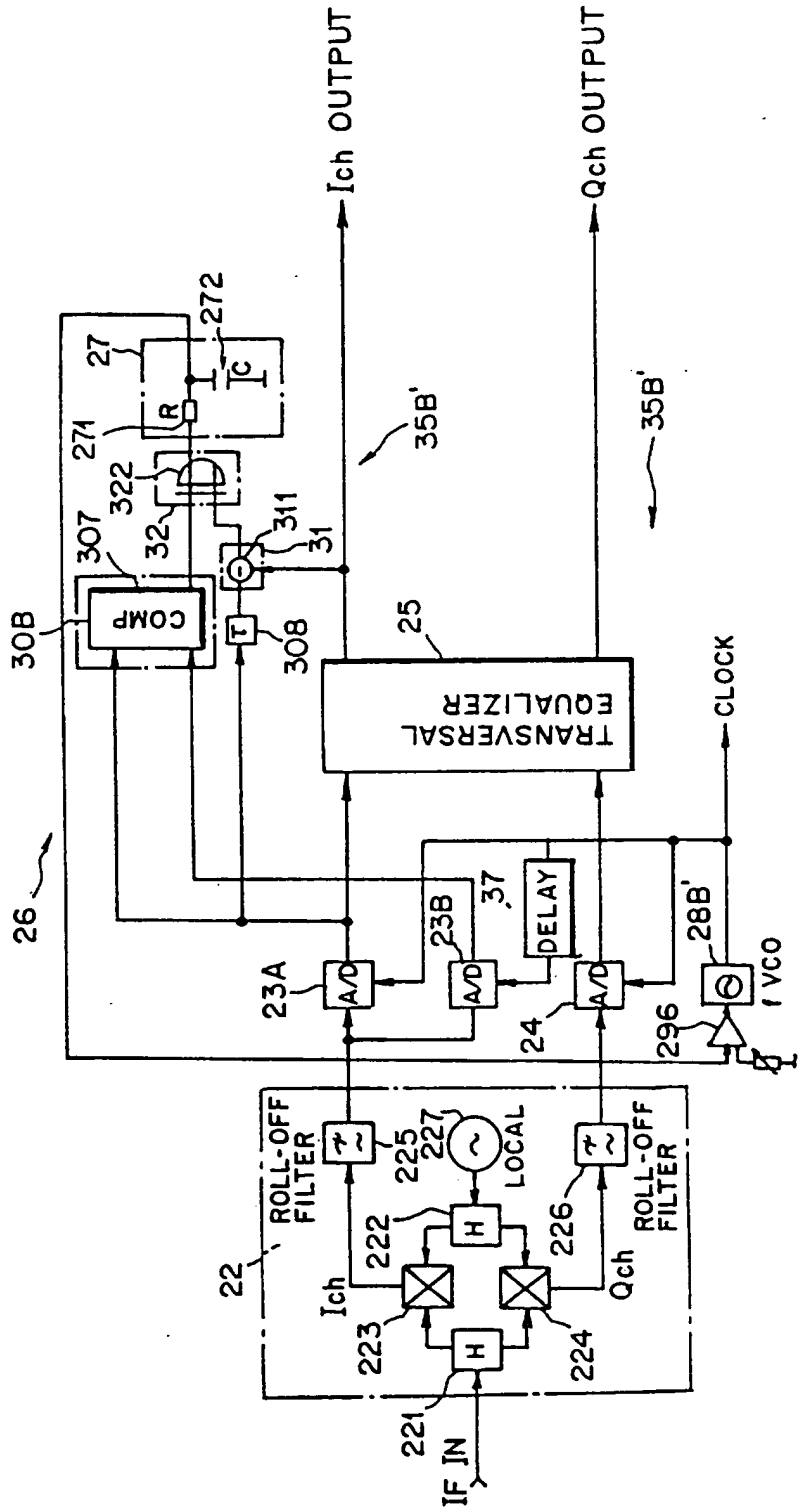

Ich OUTPUT
Qch OUTPUT
35B'
35B'
272
27
271
322
32
307
311
31
30B
COMP
308
25
TRANSVERSAL EQUALIZER
CLOCK
26
23A
A/D
23B
37
DELAY
24
28B'
VCO
296
ROLL-OFF FILTER
225
227
LOCAL
ROLL-OFF FILTER
22
222
226
Ich
Qch
223
224
221
IF IN

FIG. 32

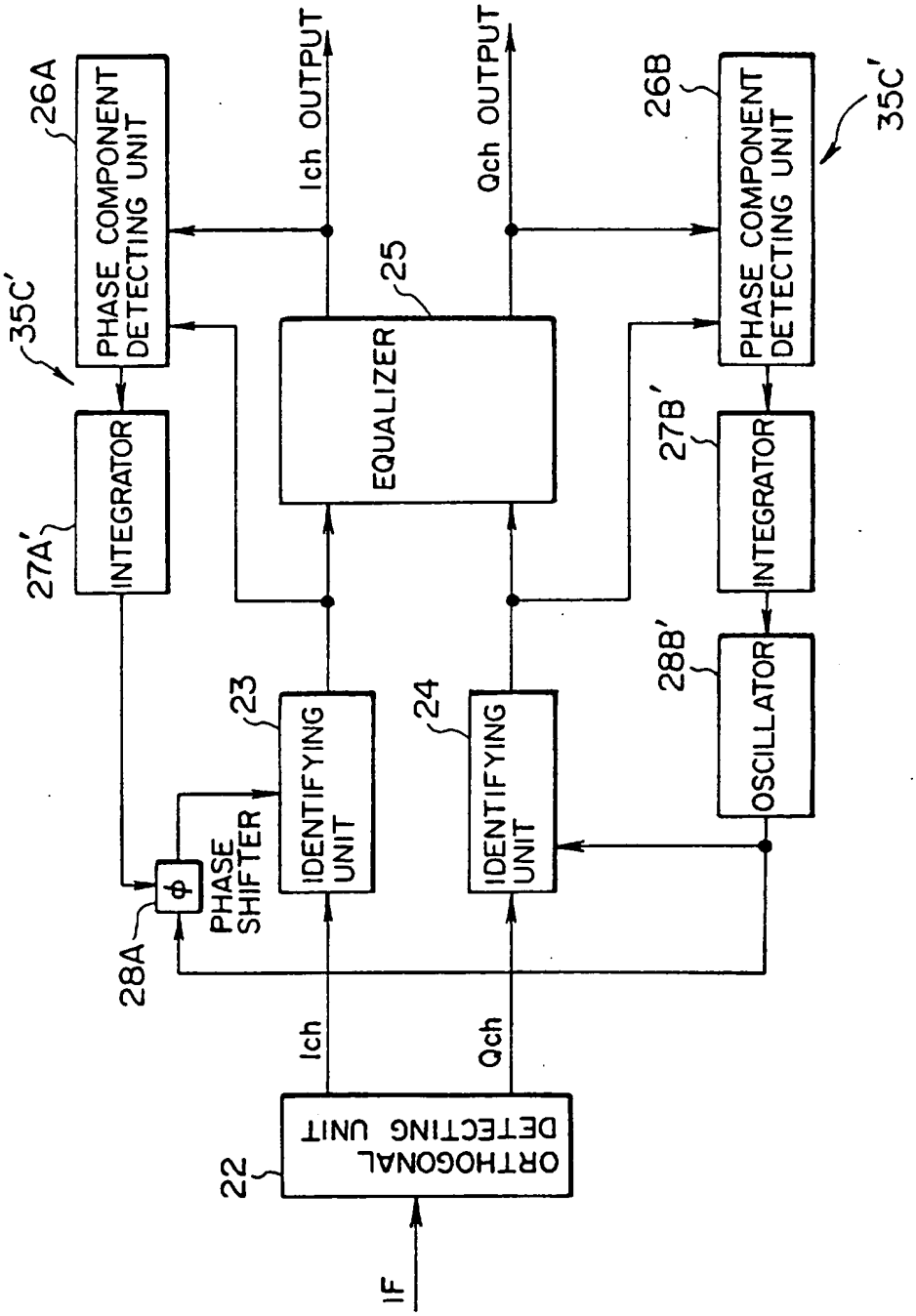

IF
ORTHOGONAL DETECTING UNIT
22
Ich
Qch
IDENTIFYING UNIT
23
IDENTIFYING UNIT
24
PHASE SHIFTER
φ
28A
EQUALIZER
25
Ich OUTPUT
Qch OUTPUT
PHASE COMPONENT DETECTING UNIT
26A
PHASE COMPONENT DETECTING UNIT
26B
35C'
35C'
INTEGRATOR
27A'
INTEGRATOR
27B'
OSCILLATOR
28B'

FIG. 33

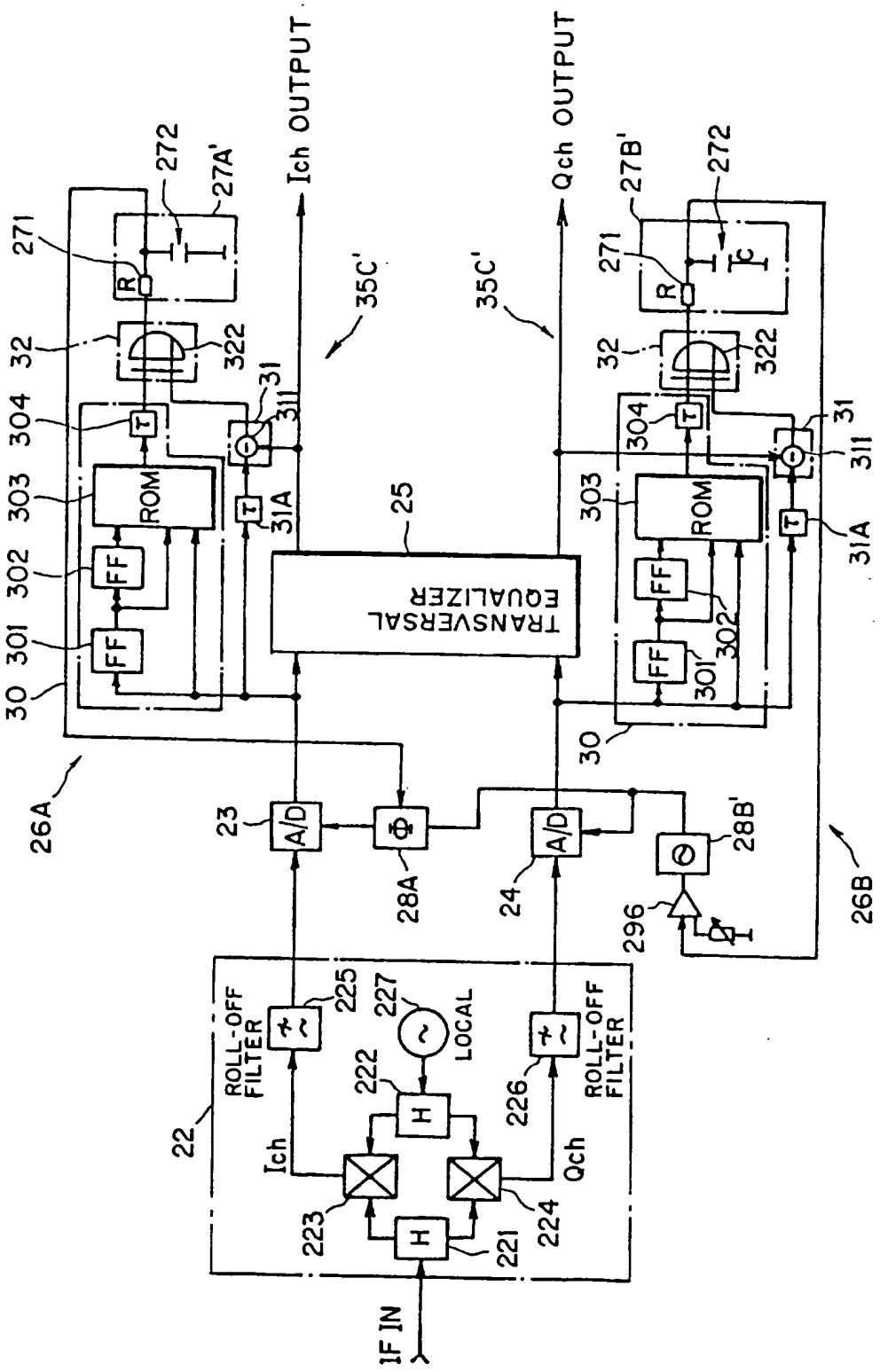

Ich OUTPUT
Qch OUTPUT
35C'
35C'
TRANSVERSAL EQUALIZER
25
ROM
FF
A/D
LOCAL
ROLL-OFF FILTER
ROLL-OFF FILTER
Ich
Qch
IF IN
26A
26B
22
23
24
27A'
27B'
28A
28B'
30
31
31A
32
271
272
296
301
302
303
304
311
322
221
222
223
224
225
226
227

FIG. 34

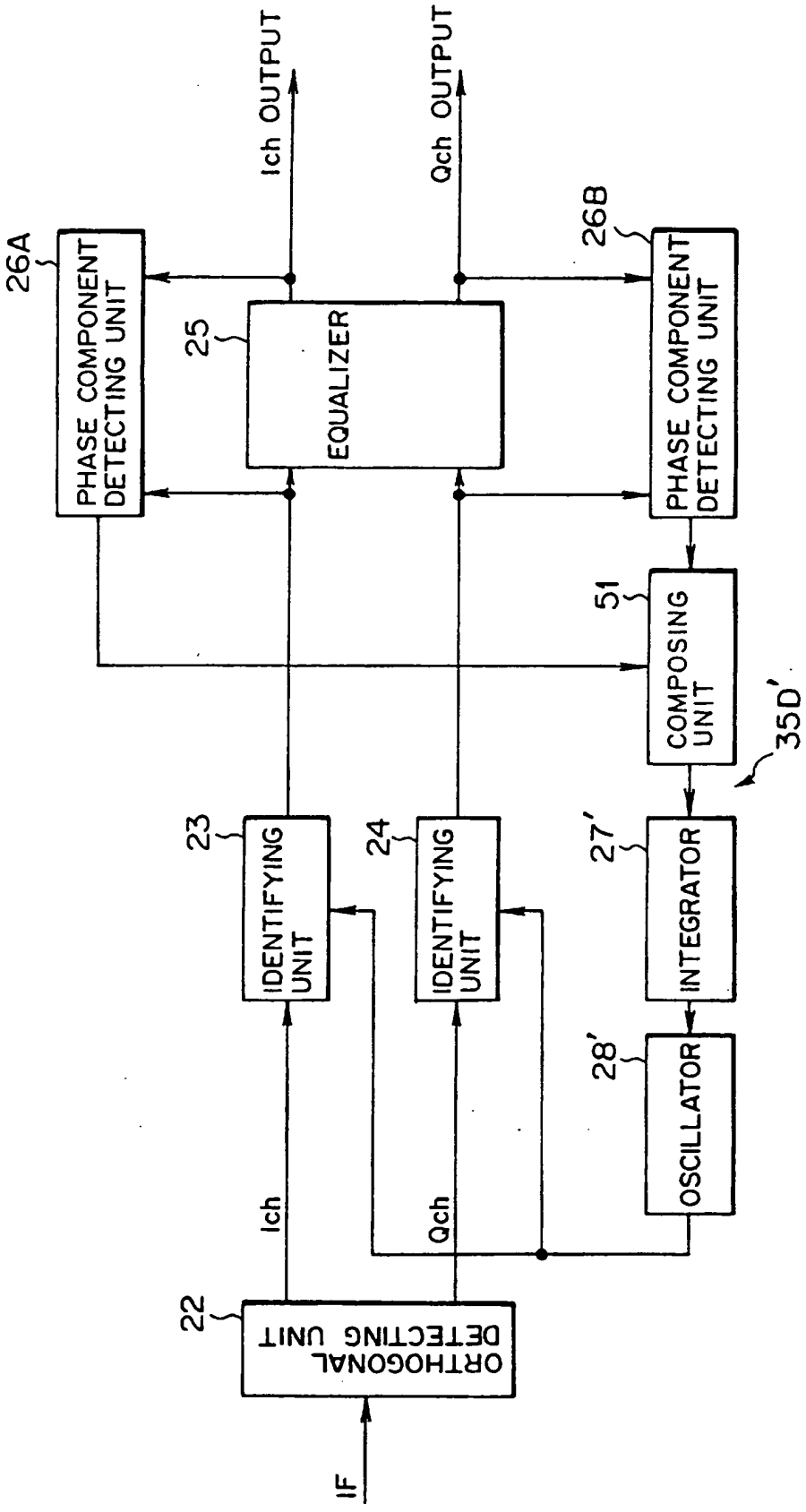

Ich OUTPUT
Qch OUTPUT
26A
PHASE COMPONENT DETECTING UNIT
25
EQUALIZER
26B
PHASE COMPONENT DETECTING UNIT
51
COMPOSING UNIT
35D'
23
IDENTIFYING UNIT
24
IDENTIFYING UNIT
27'
INTEGRATOR
28'
OSCILLATOR
Ich
Qch
22
ORTHOGONAL DETECTING UNIT
IF

FIG. 35

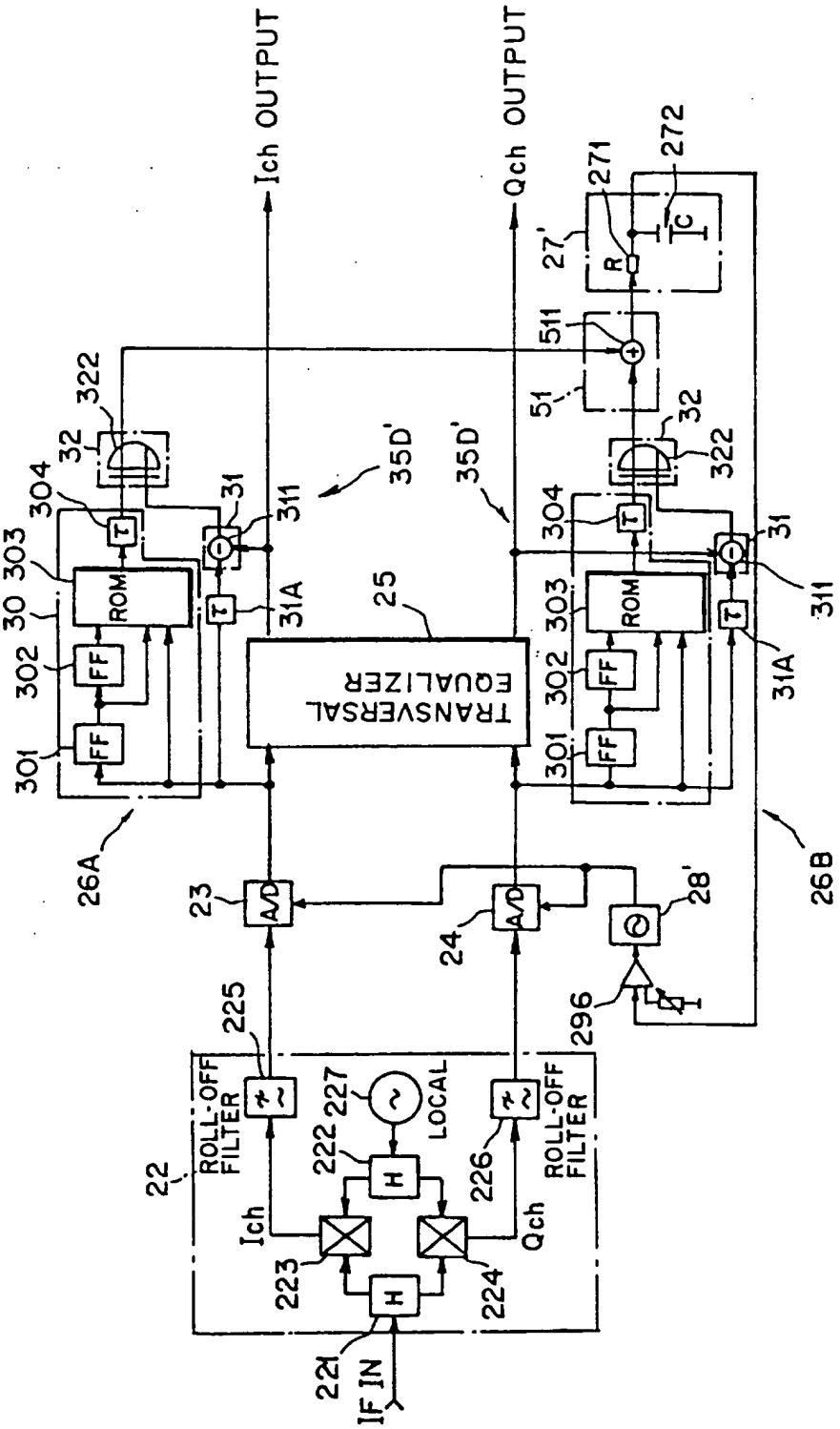

Ich OUTPUT
Qch OUTPUT
TRANSVERSAL EQUALIZER
ROM
FF
A/D
LOCAL
ROLL-OFF FILTER
IF IN
Ich
Qch

FIG. 36

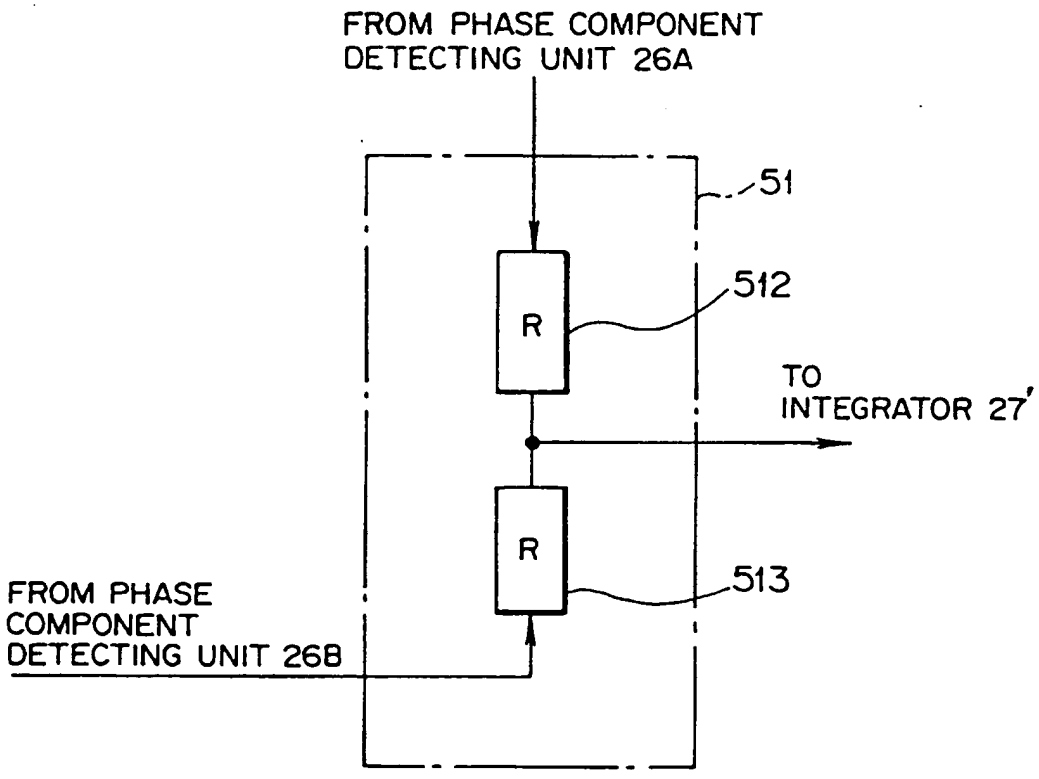

FROM PHASE COMPONENT DETECTING UNIT 26A
51
512
R
TO INTEGRATOR 27'
R
513
FROM PHASE COMPONENT DETECTING UNIT 26B

FIG.37

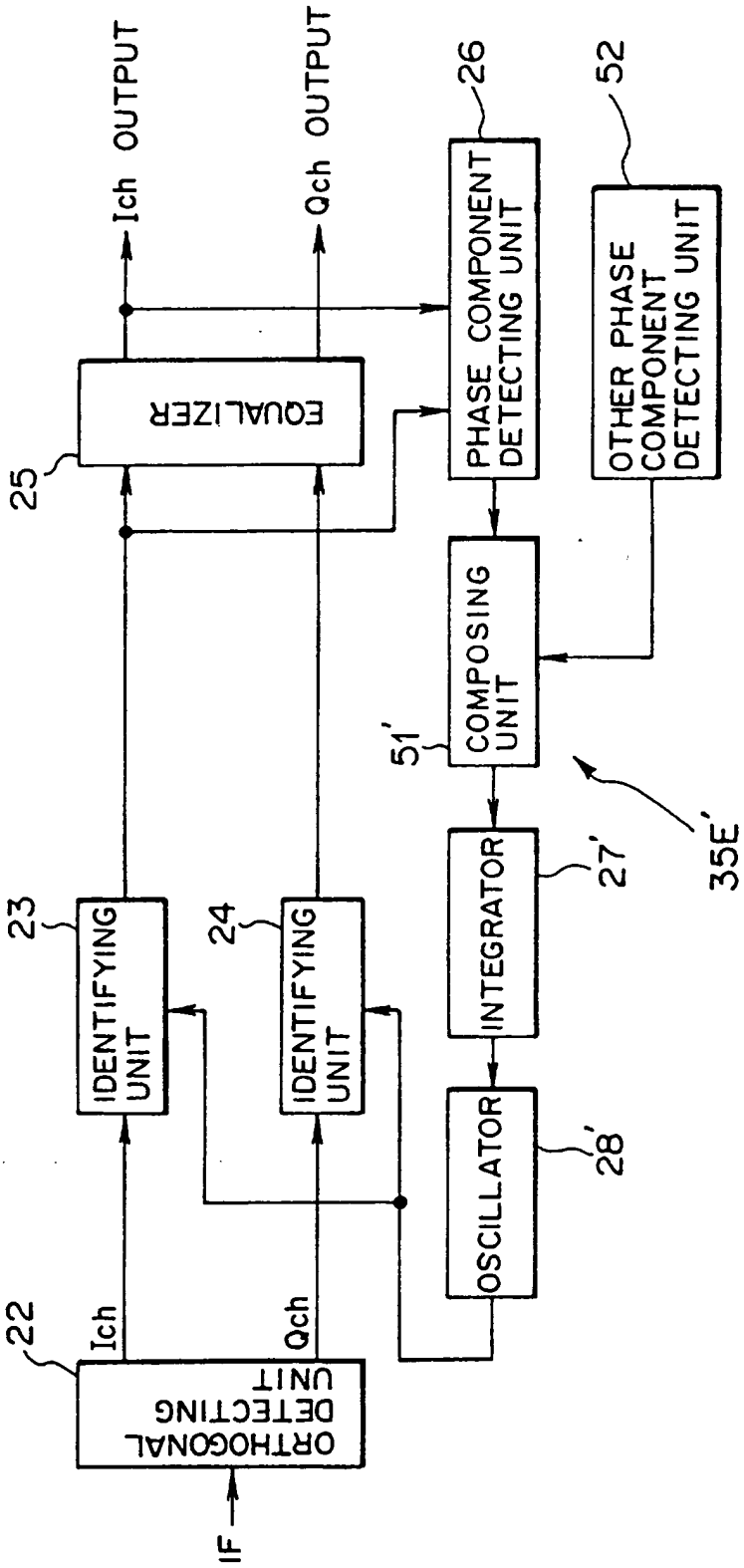

Ich OUTPUT
Qch OUTPUT
26
52
PHASE COMPONENT DETECTING UNIT
OTHER PHASE COMPONENT DETECTING UNIT
EQUALIZER
25
COMPOSING UNIT
51'
35E'
27'
INTEGRATOR
23
24
IDENTIFYING UNIT
IDENTIFYING UNIT
OSCILLATOR
28'
22
Ich
Qch
ORTHOGONAL DETECTING UNIT
IF

FIG. 38

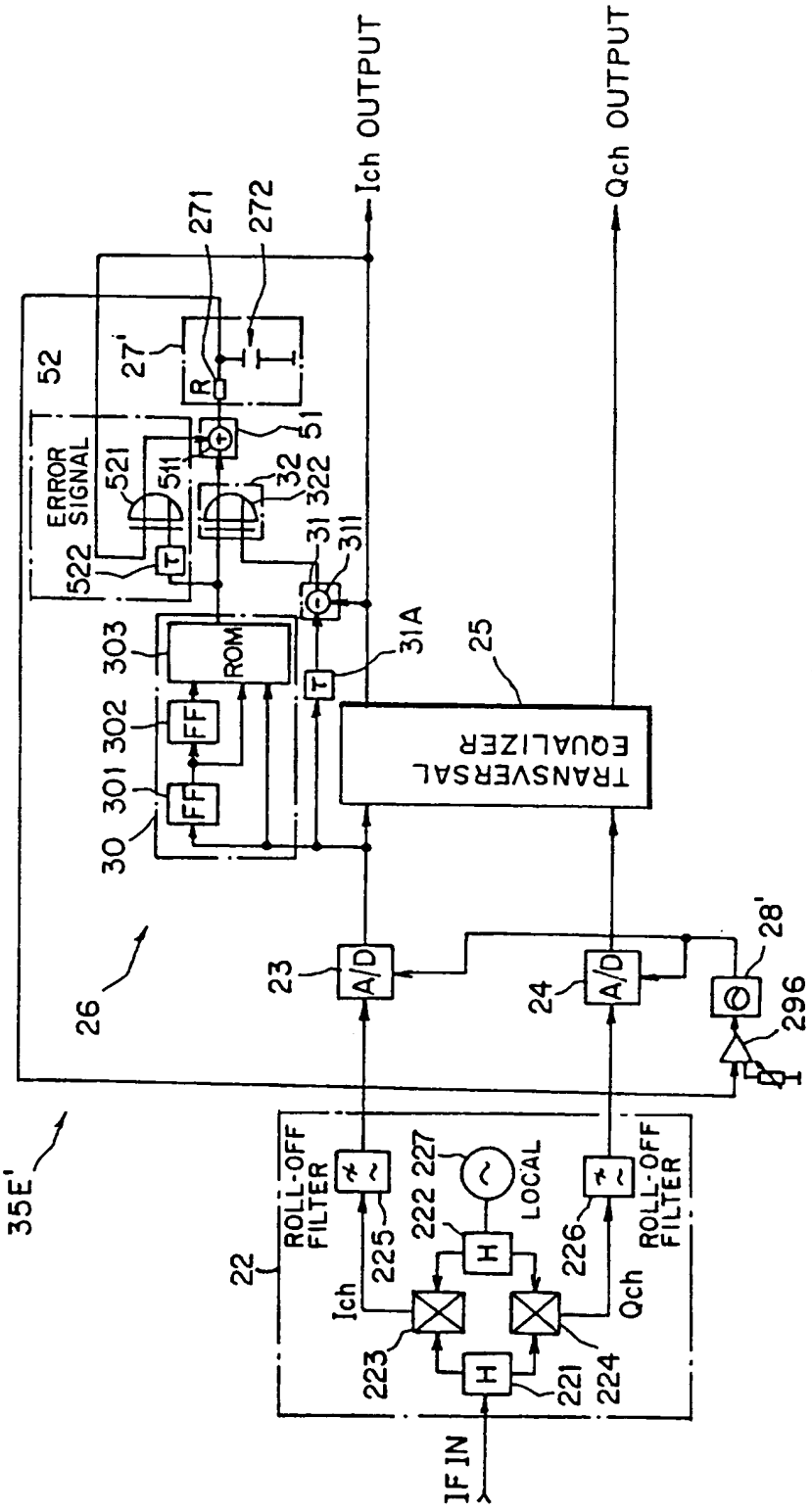

Ich OUTPUT
Qch OUTPUT
271
272
52
27'
R
I
I
51
ERROR SIGNAL
521
511
32
322
31
311
522
T
303
ROM
31A
25
302
FF
301
FF
30
TRANSVERSAL EQUALIZER
26
23
A/D
24
A/D
28'
296
35E'
ROLL-OFF FILTER
227
LOCAL
222
225
226
ROLL-OFF FILTER
22
Ich
Qch
223
221
224
IF IN

FIG. 39

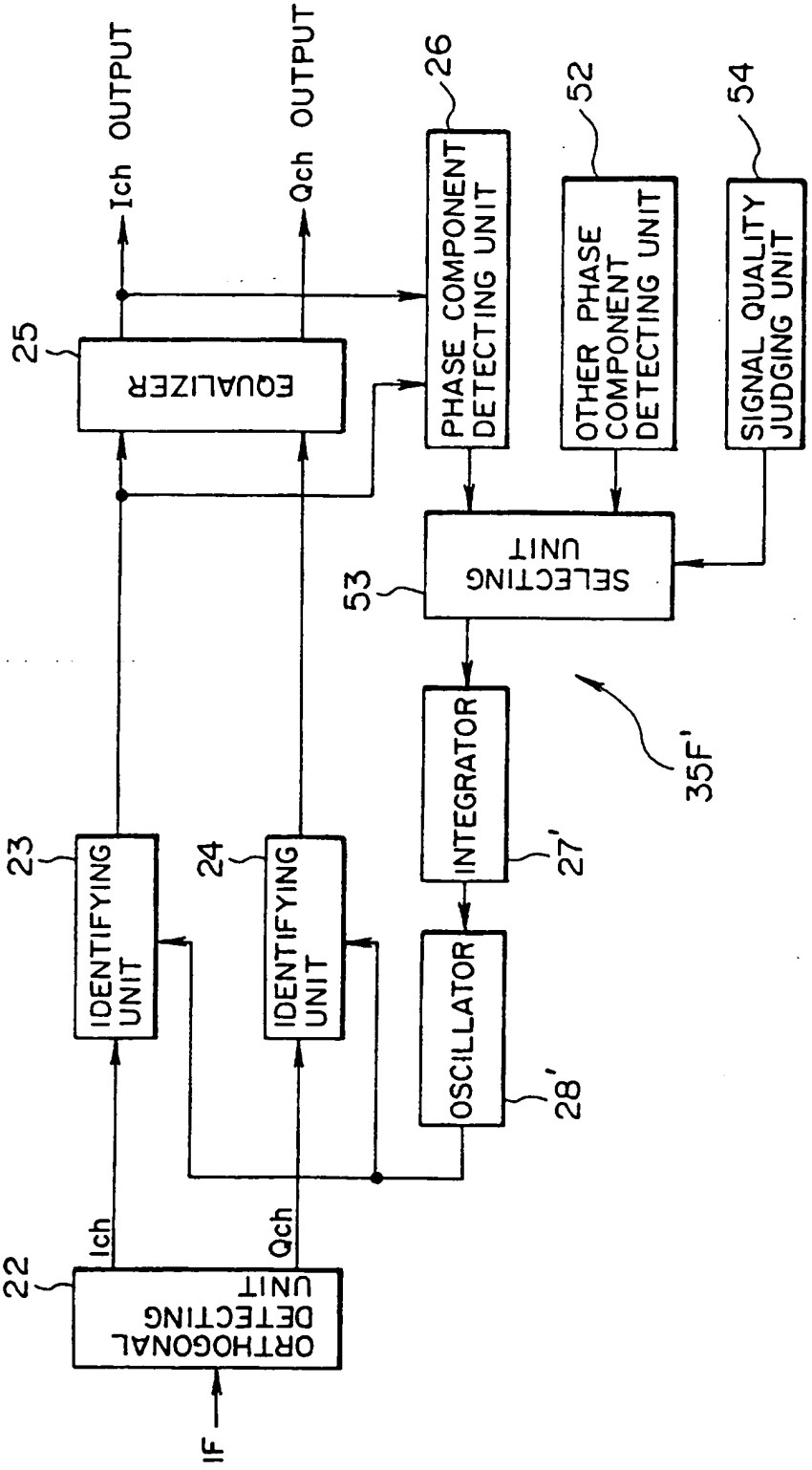
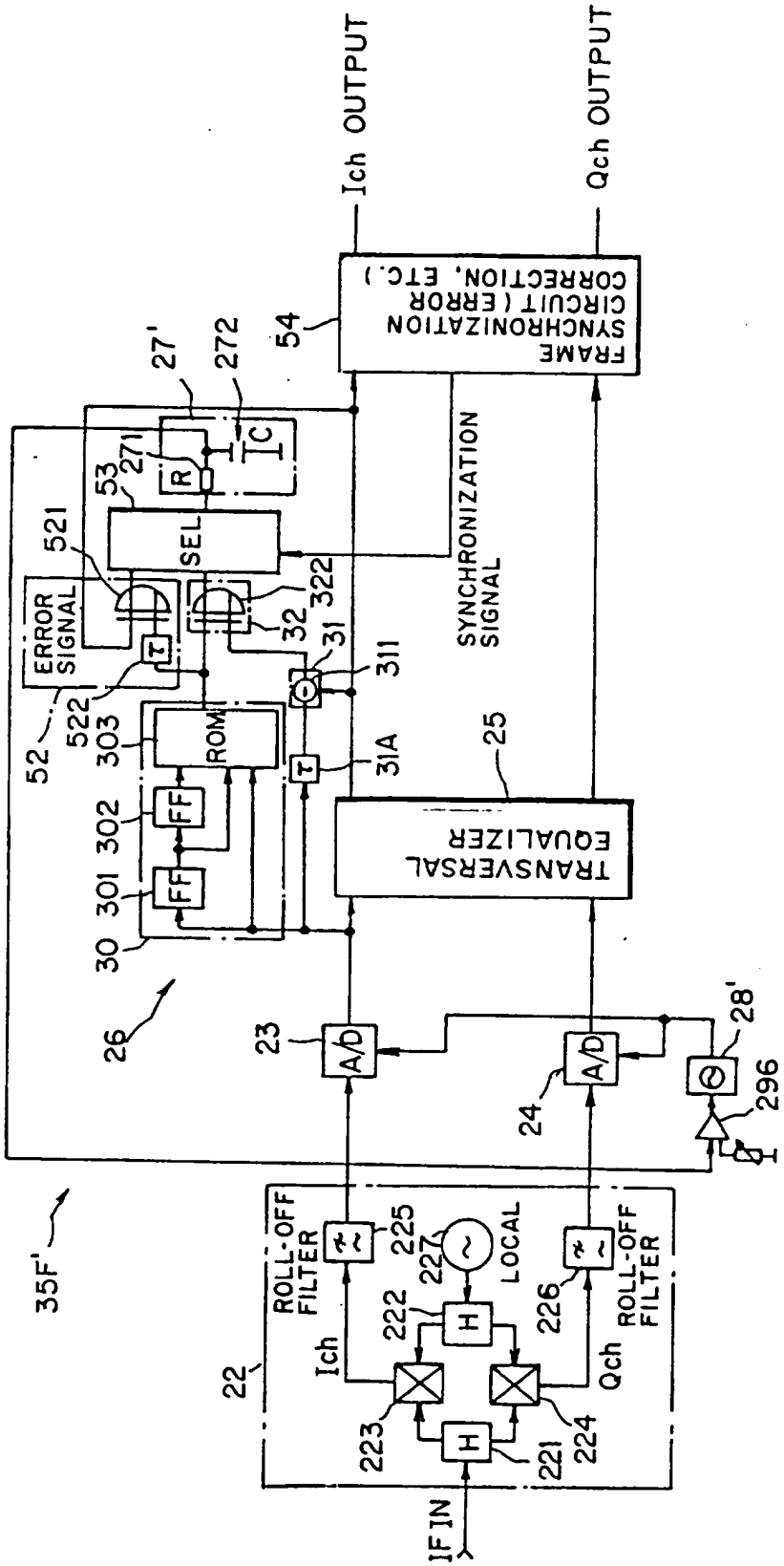

IF
ORTHOGONAL DETECTING UNIT
22
Ich
Qch
IDENTIFYING UNIT
23
IDENTIFYING UNIT
24
OSCILLATOR
28'
INTEGRATOR
27'
35F'
SELECTING UNIT
53
EQUALIZER
25
PHASE COMPONENT DETECTING UNIT
26
OTHER PHASE COMPONENT DETECTING UNIT
52
SIGNAL QUALITY JUDGING UNIT
54
Ich OUTPUT
Qch OUTPUT

FIG. 40


Ich OUTPUT
Qch OUTPUT
FRAME SYNCHRONIZATION CIRCUIT (ERROR CORRECTION, ETC.)
54
27'
272
271
53
R
IC
SEL
521
ERROR SIGNAL
522
52
SYNCHRONIZATION SIGNAL
322
32
31
311
303
ROM
31A
25
TRANSVERSAL EQUALIZER
302
FF
301
30
26
23
A/D
24
28'
296
35F'
ROLL-OFF FILTER
225
227
LOCAL
222
H
226
Ich
Qch
223
224
221
22
IF IN

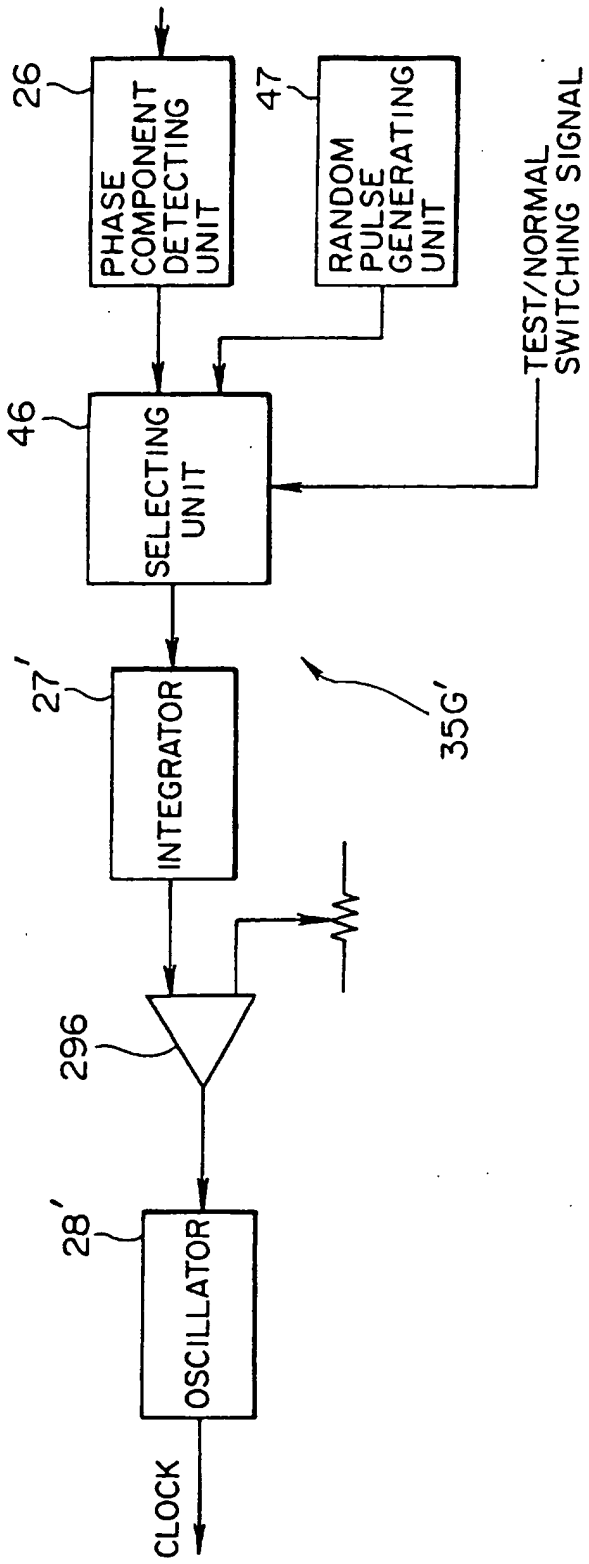

26
PHASE COMPONENT DETECTING UNIT
47
RANDOM PULSE GENERATING UNIT
TEST/NORMAL SWITCHING SIGNAL
46
SELECTING UNIT
27'
INTEGRATOR
35G'
296
28'
OSCILLATOR
CLOCK

FIG. 41

FIG. 42

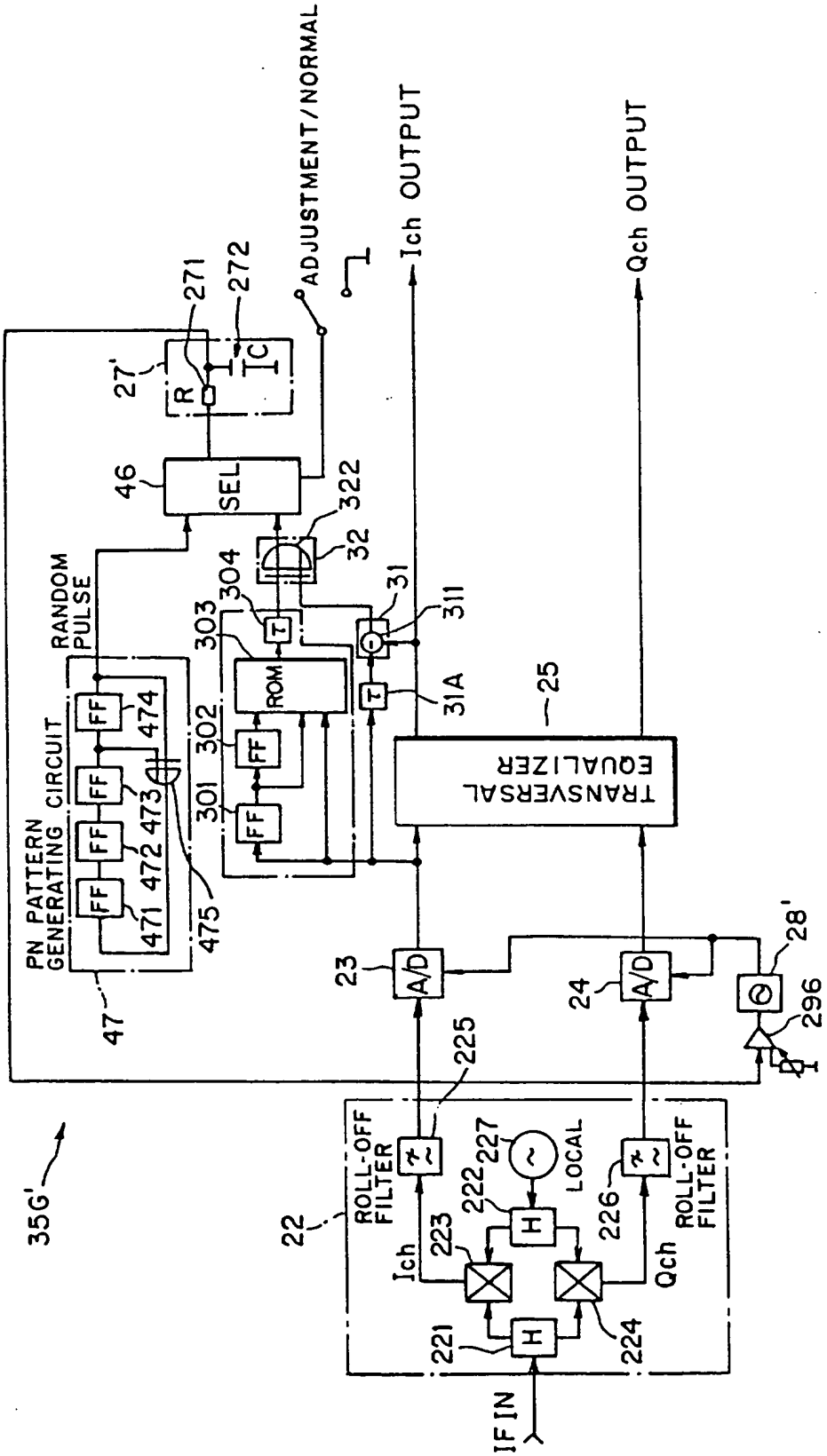

ADJUSTMENT/NORMAL
Ich OUTPUT
Qch OUTPUT
271
272
27'
R
TC
46
SEL
322
32
31
311
304
303
RANDOM PULSE
ROM
302
301
31A
25
TRANSVERSAL EQUALIZER
PN PATTERN GENERATING CIRCUIT
FF
474
473
472
471
475
47
23
24
A/D
28'
296
225
35G'
22
ROLL-OFF FILTER
227
LOCAL
222
223
226
Ich
Qch
221
224
IFIN

FIG.43

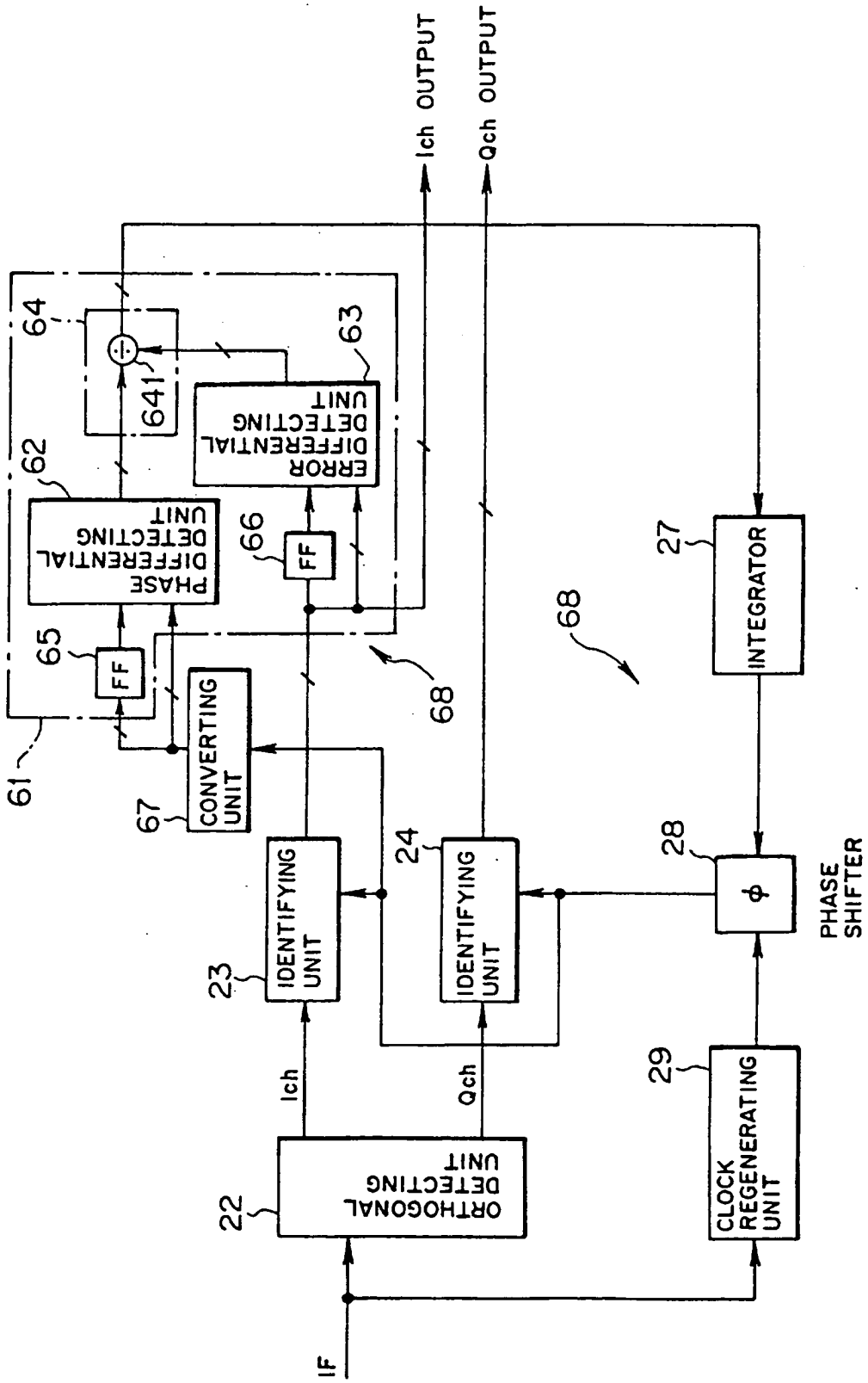

Ich OUTPUT
Qch OUTPUT
64
63
641
ERROR DIFFERENTIAL DETECTING UNIT
62
PHASE DIFFERENTIAL DETECTING UNIT
66
FF
65
FF
61
68
68
CONVERTING UNIT
67
27
INTEGRATOR
28
Φ
PHASE SHIFTER
24
IDENTIFYING UNIT
23
IDENTIFYING UNIT
Ich
Qch
29
CLOCK REGENERATING UNIT
22
ORTHOGONAL DETECTING UNIT
IF

FIG. 44

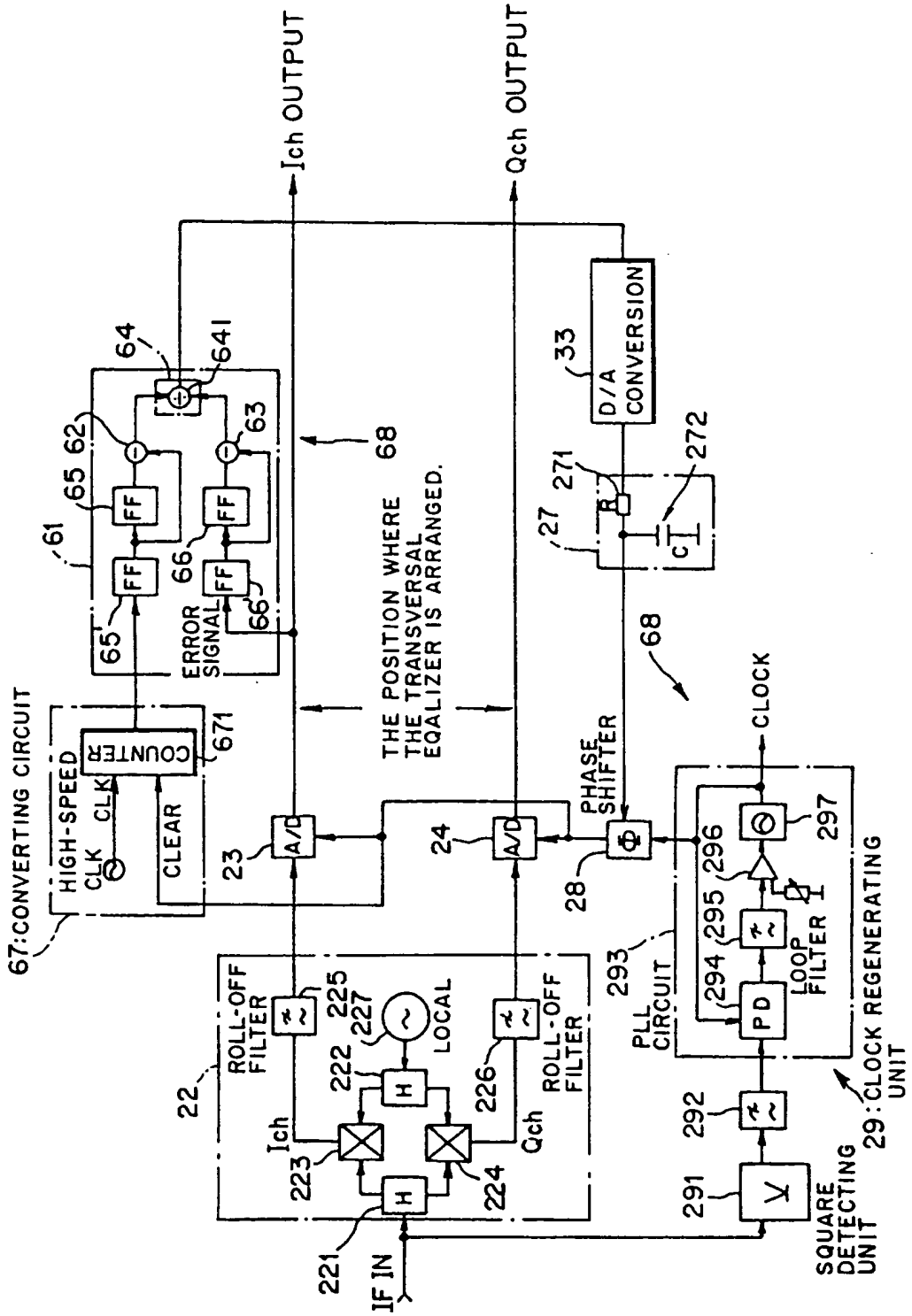
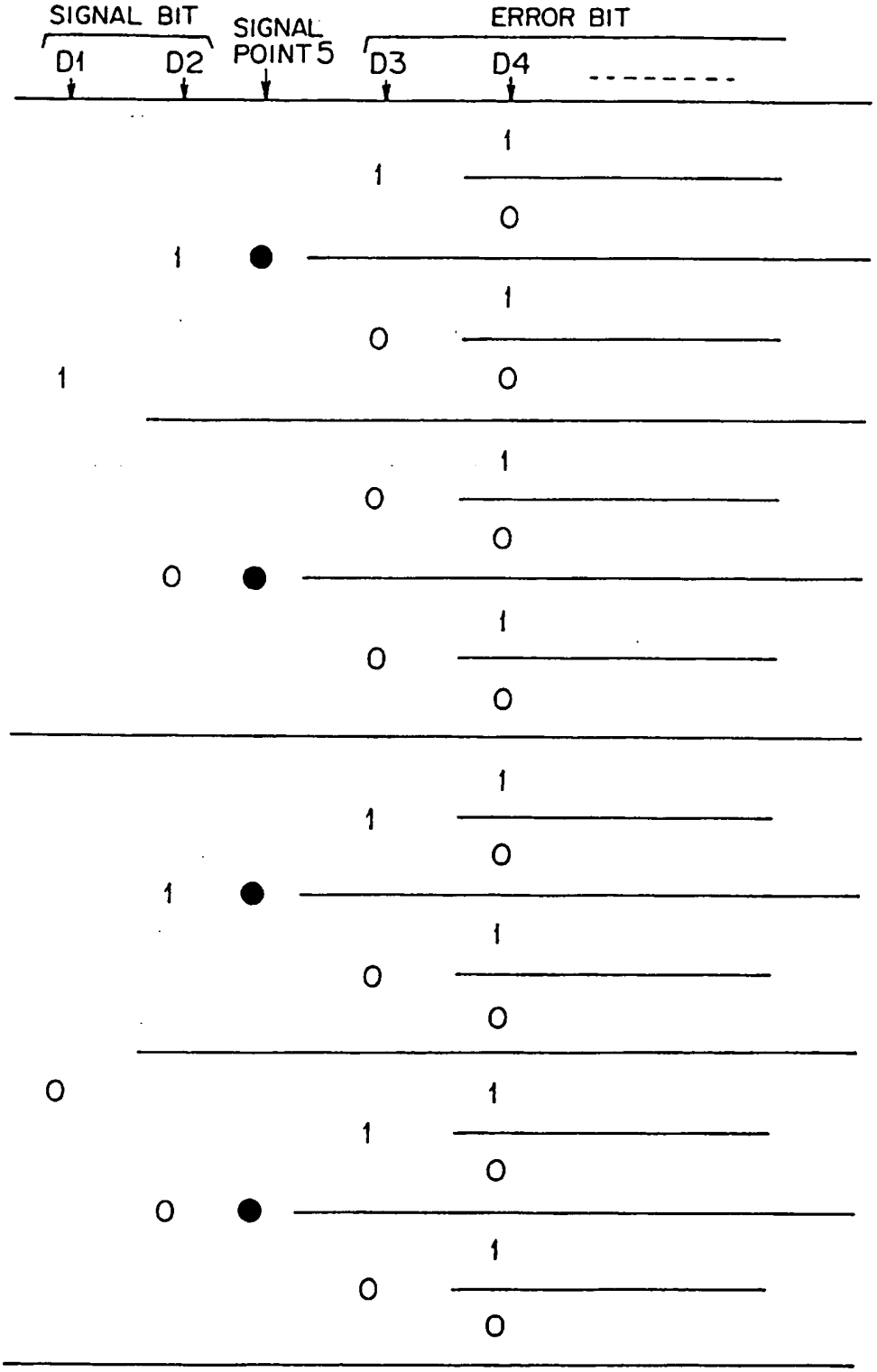

Ich OUTPUT
Qch OUTPUT
D/A CONVERSION
33
64
641
63
62
65
61
FF
66
ERROR SIGNAL
68
THE POSITION WHERE THE TRANSVERSAL EQALIZER IS ARRANGED.
27
271
272
R
cT
67:CONVERTING CIRCUIT
HIGH-SPEED
CLK
COUNTER
671
CLEAR
A/D
23
24
PHASE SHIFTER
28
CLOCK
297
296
295
294
293
PLL CIRCUIT
PD
LOOP FILTER
ROLL-OFF FILTER
22
225
227
LOCAL
222
226
Ich
Qch
223
224
221
IF IN
292
291
SQUARE DETECTING UNIT
29:CLOCK REGENERATING UNIT

FIG. 45



US005867542A

FIG.46

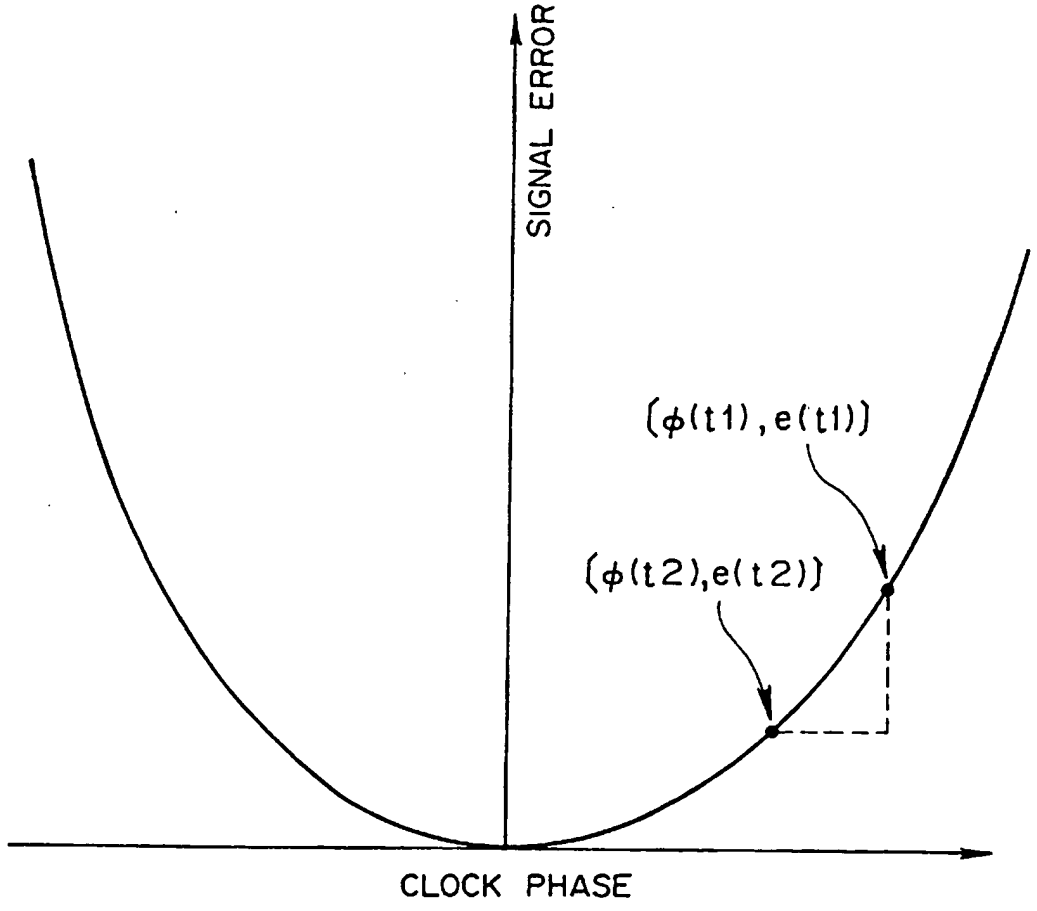


FIG. 47

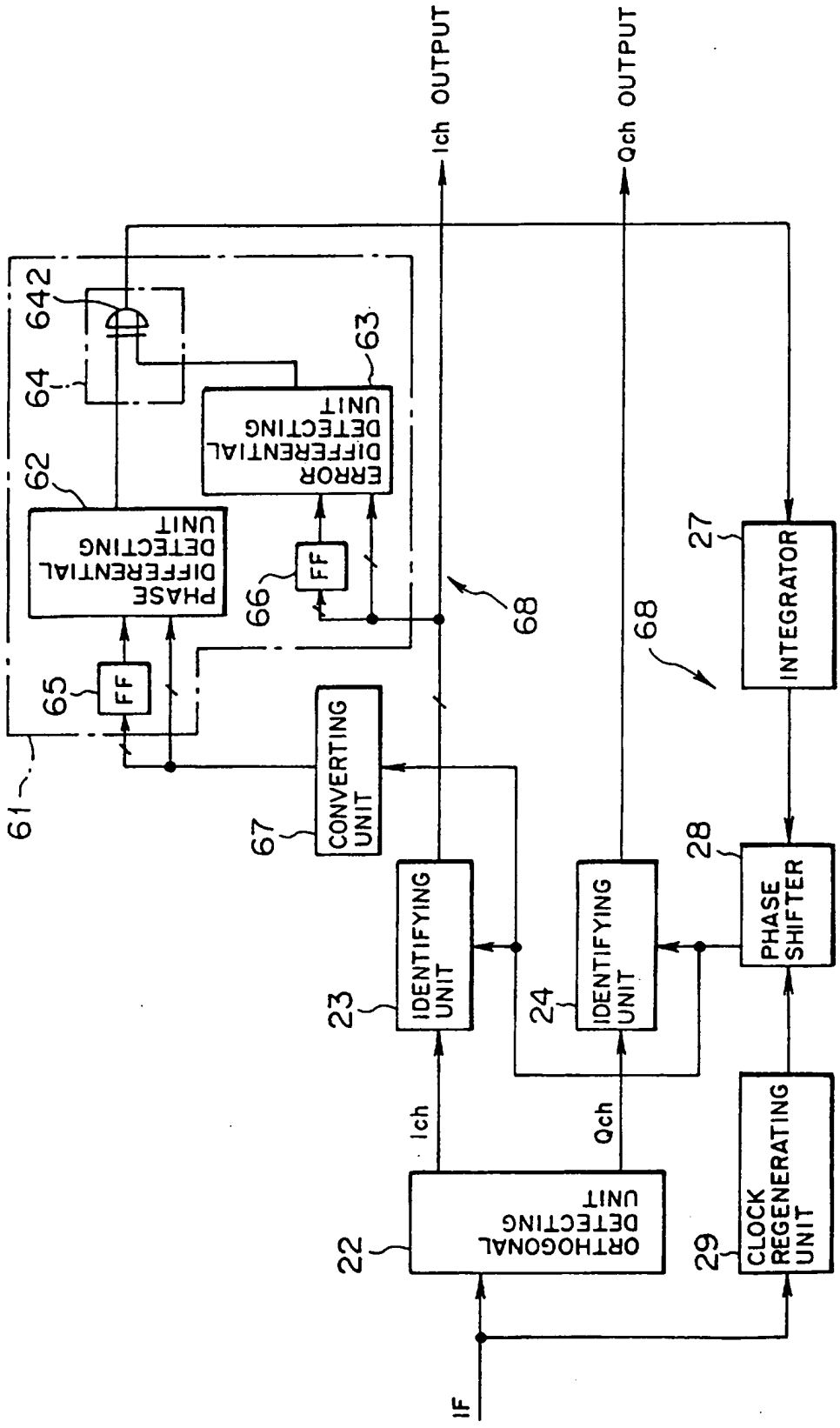

Ich OUTPUT
Qch OUTPUT
642
64
63
ERROR DIFFERENTIAL DETECTING UNIT
62
PHASE DIFFERENTIAL DETECTING UNIT
FF
66
68
65
FF
61
CONVERTING UNIT
67
27
INTEGRATOR
68
28
PHASE SHIFTER
23
IDENTIFYING UNIT
24
IDENTIFYING UNIT
Ich
Qch
22
ORTHOGONAL DETECTING UNIT
29
CLOCK REGENERATING UNIT
IF

FIG. 48

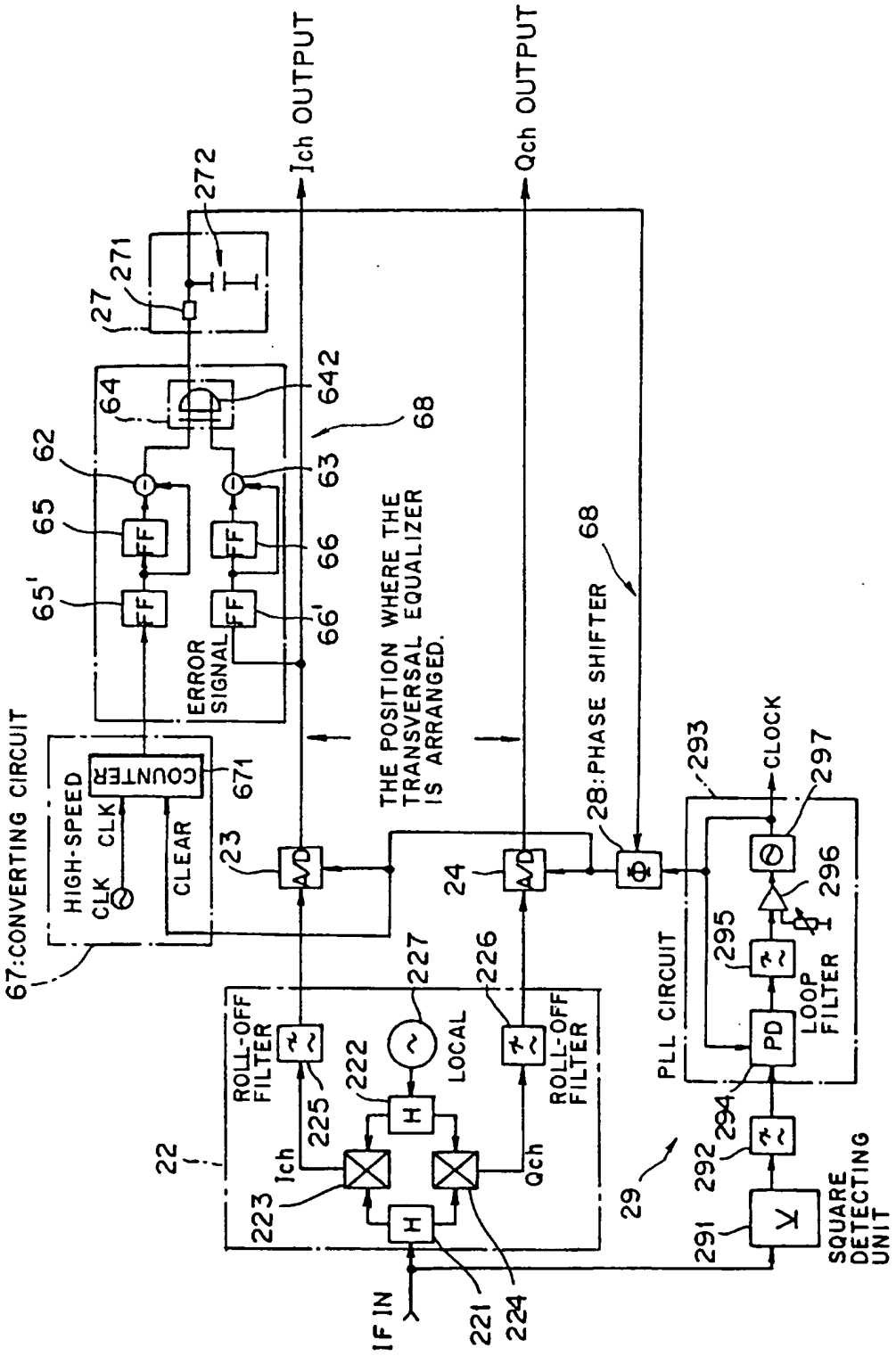

Ich OUTPUT
Qch OUTPUT
272
271
27
642
64
68
62
63
65
66
65'
66'
FF
ERROR SIGNAL
THE POSITION WHERE THE TRANSVERSAL EQUALIZER IS ARRANGED.
68
28:PHASE SHIFTER
293
CLOCK
297
67:CONVERTING CIRCUIT
HIGH-SPEED CLK
CLK
COUNTER
671
CLEAR
23
24
A/D
Φ
227
226
ROLL-OFF FILTER
LOCAL
222
225
Ich
Qch
223
22
H
221
224
IF IN
PLL CIRCUIT
295
296
PD
LOOP FILTER
294
292
29
291
SQUARE DETECTING UNIT

FIG. 49

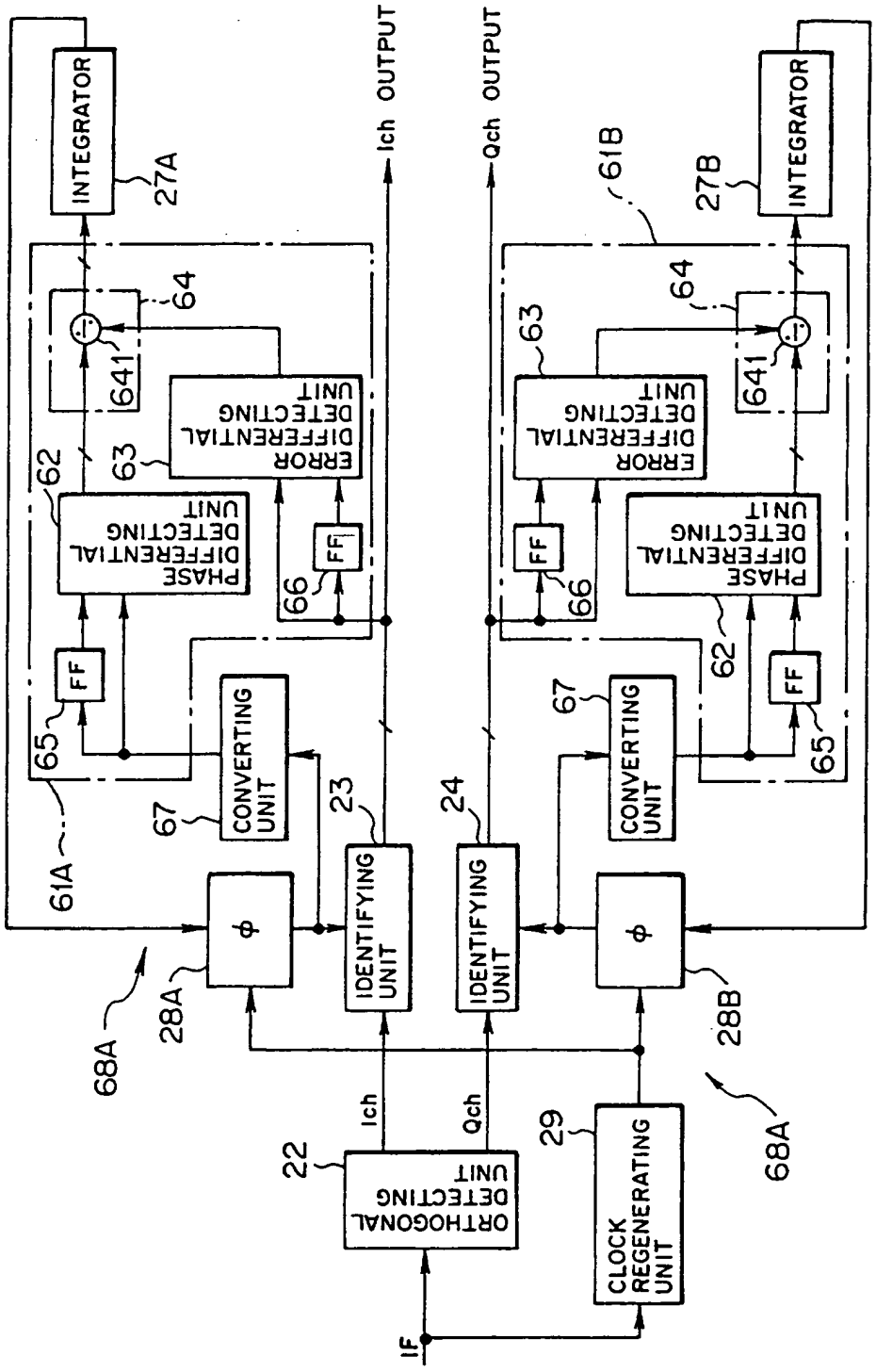

INTEGRATOR
27A
Ich OUTPUT
Qch OUTPUT
61B
27B
INTEGRATOR
64
641
63
ERROR DIFFERENTIAL DETECTING UNIT
62
PHASE DIFFERENTIAL DETECTING UNIT
FF
66
65
67
CONVERTING UNIT
23
24
61A
IDENTIFYING UNIT
φ
28A
28B
68A
Ich
Qch
22
ORTHOGONAL DETECTING UNIT
29
CLOCK REGENERATING UNIT
IF

FIG. 50

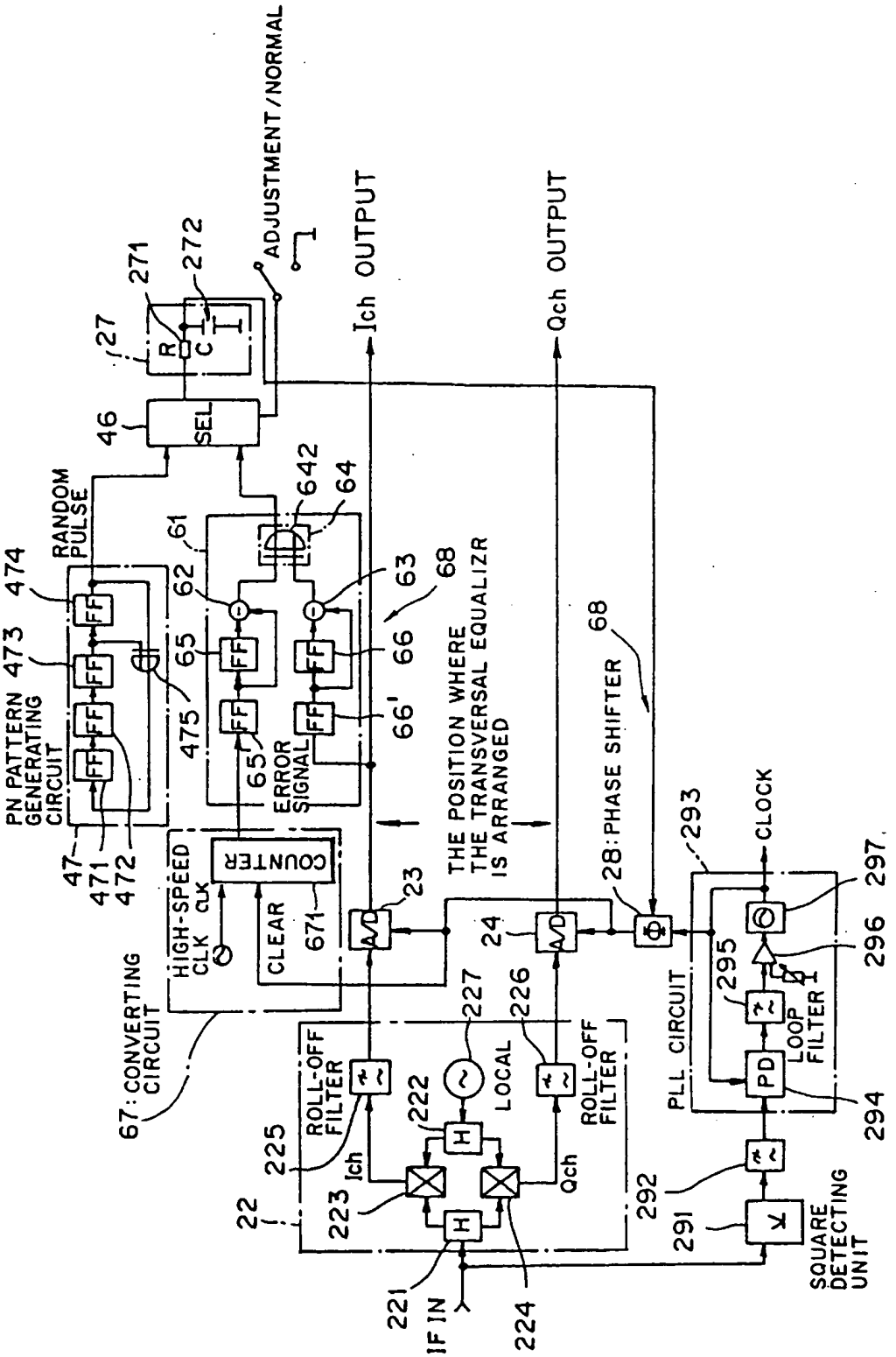

ADJUSTMENT/NORMAL
Ich OUTPUT
Qch OUTPUT
RANDOM PULSE
PN PATTERN GENERATING CIRCUIT
ERROR SIGNAL
THE POSITION WHERE THE TRANSVERSAL EQUALIZR IS ARRANGED
28: PHASE SHIFTER
67: CONVERTING CIRCUIT
HIGH-SPEED CLK
CLEAR
COUNTER
ROLL-OFF FILTER
LOCAL
PLL CIRCUIT
LOOP FILTER
CLOCK
SQUARE DETECTING UNIT
IF IN
SEL
PD

FIG. 51

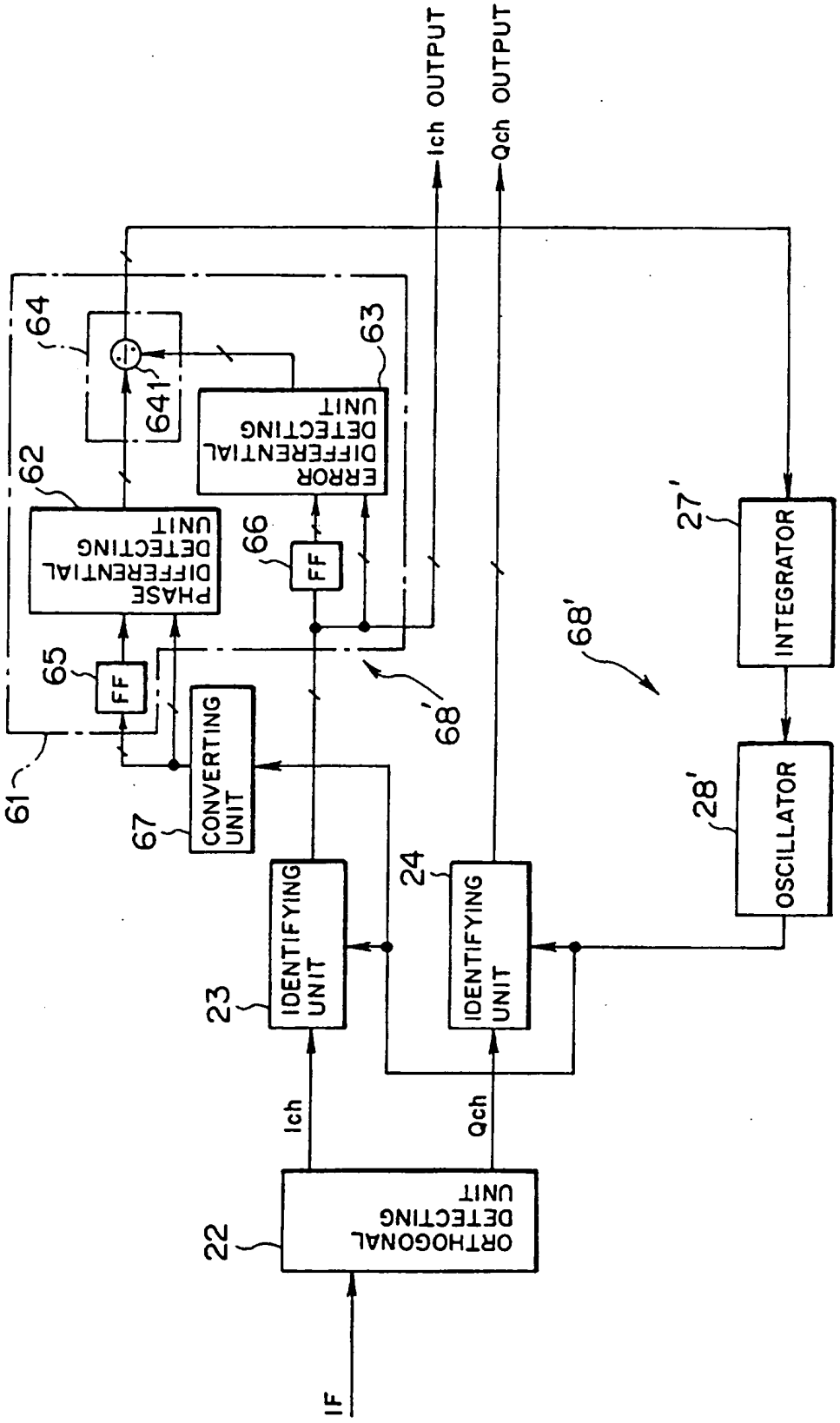

Ich OUTPUT
Qch OUTPUT
64
641
63
ERROR DIFFERENTIAL DETECTING UNIT
62
PHASE DIFFERENTIAL DETECTING UNIT
66
FF
65
FF
61
67
CONVERTING UNIT
68'
68'
27'
INTEGRATOR
28'
OSCILLATOR
23
IDENTIFYING UNIT
24
IDENTIFYING UNIT
Ich
Qch
22
ORTHOGONAL DETECTING UNIT
IF

FIG. 52

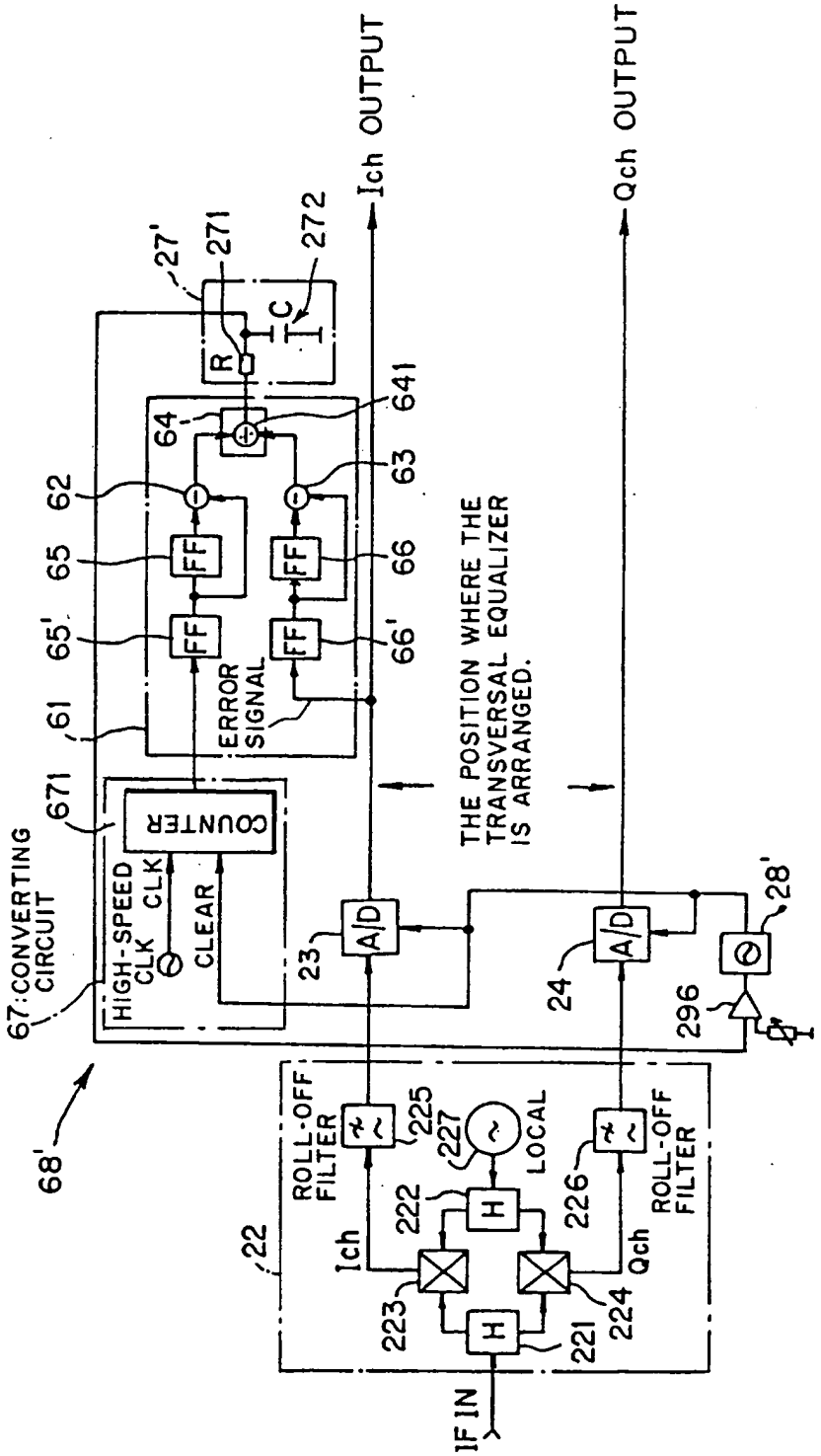

Ich OUTPUT
Qch OUTPUT
27'
271
272
R
C
I
64
641
62
63
65
66
65'
66'
FF
61
ERROR SIGNAL
671
COUNTER
HIGH-SPEED CLK
CLK
CLEAR
67:CONVERTING CIRCUIT
THE POSITION WHERE THE TRANSVERSAL EQUALIZER IS ARRANGED.
A/D
23
24
28'
296
68'
22
ROLL-OFF FILTER
225
227
LOCAL
222
226
Ich
Qch
H
223
224
221
IF IN

FIG. 53

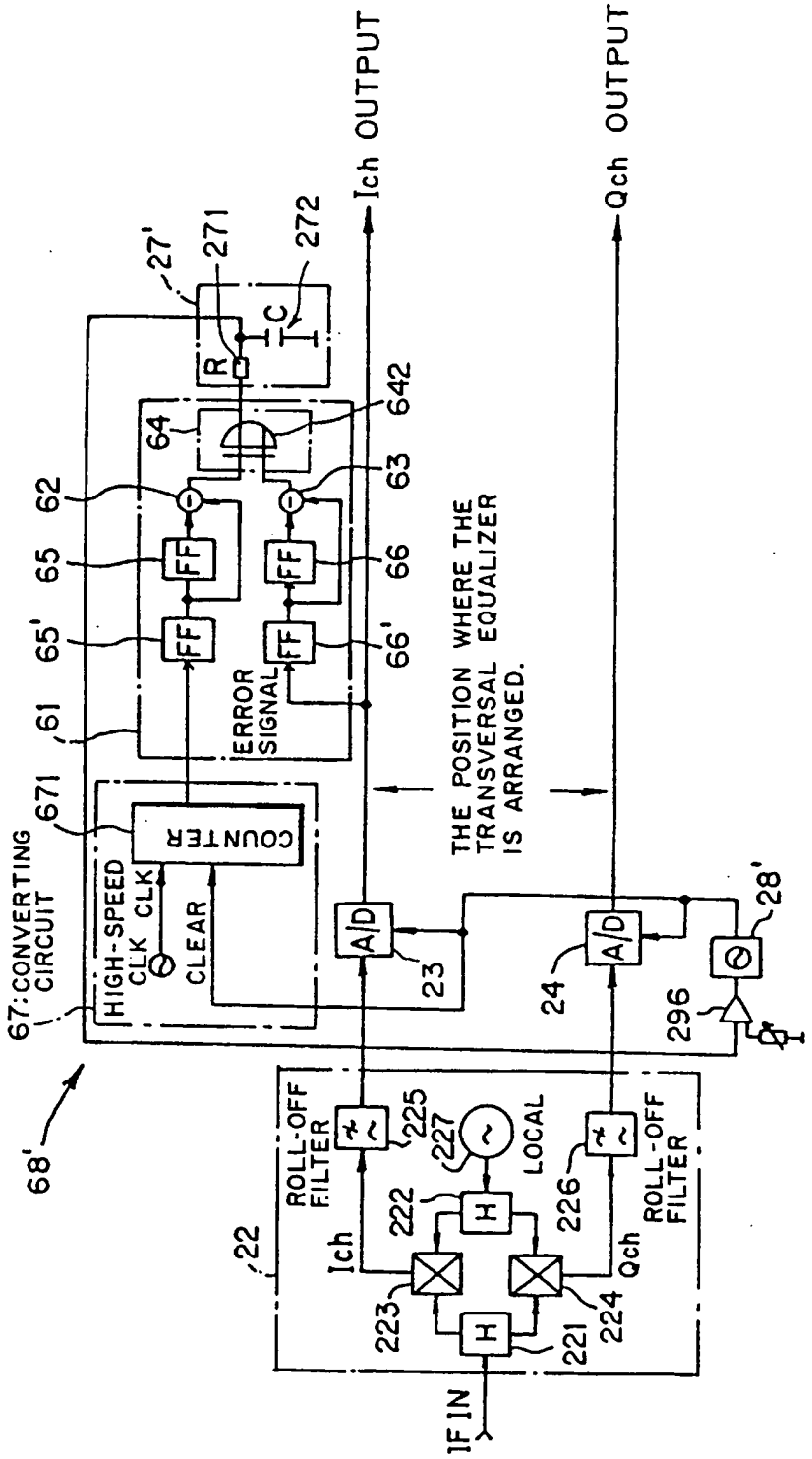

Ich OUTPUT
Qch OUTPUT
27'
271
272
R
IC
II
642
64
62
63
65
66
65'
66'
FF
ERROR SIGNAL
61
671
COUNTER
HIGH-SPEED CLK
CLK
CLEAR
67: CONVERTING CIRCUIT
THE POSITION WHERE THE TRANSVERSAL EQUALIZER IS ARRANGED.
A/D
23
24
28'
296
68'
ROLL-OFF FILTER
225
227
LOCAL
222
226
22
Ich
Qch
223
224
221
IFIN

FIG. 54

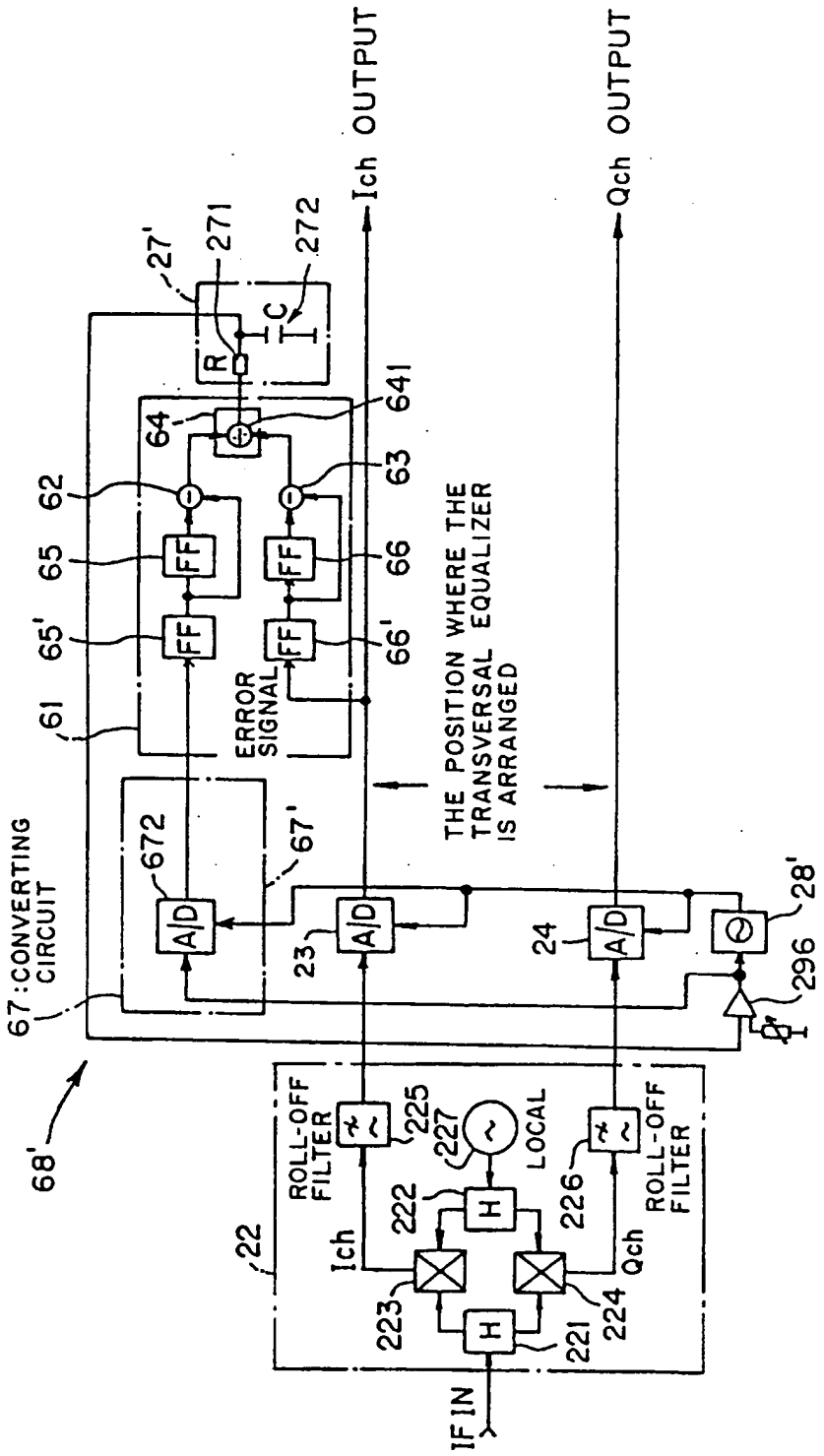

Ich OUTPUT
Qch OUTPUT
27'
271
272
R
IC
64
641
62
63
65
66
65'
66'
61
FF
ERROR SIGNAL
THE POSITION WHERE THE TRANSVERSAL EQUALIZER IS ARRANGED
672
67'
A/D
23
24
28'
296
67 :CONVERTING CIRCUIT
68'
ROLL-OFF FILTER
225
227
LOCAL
222
226
H
22
Ich
Qch
223
224
221
IF IN

FIG. 55

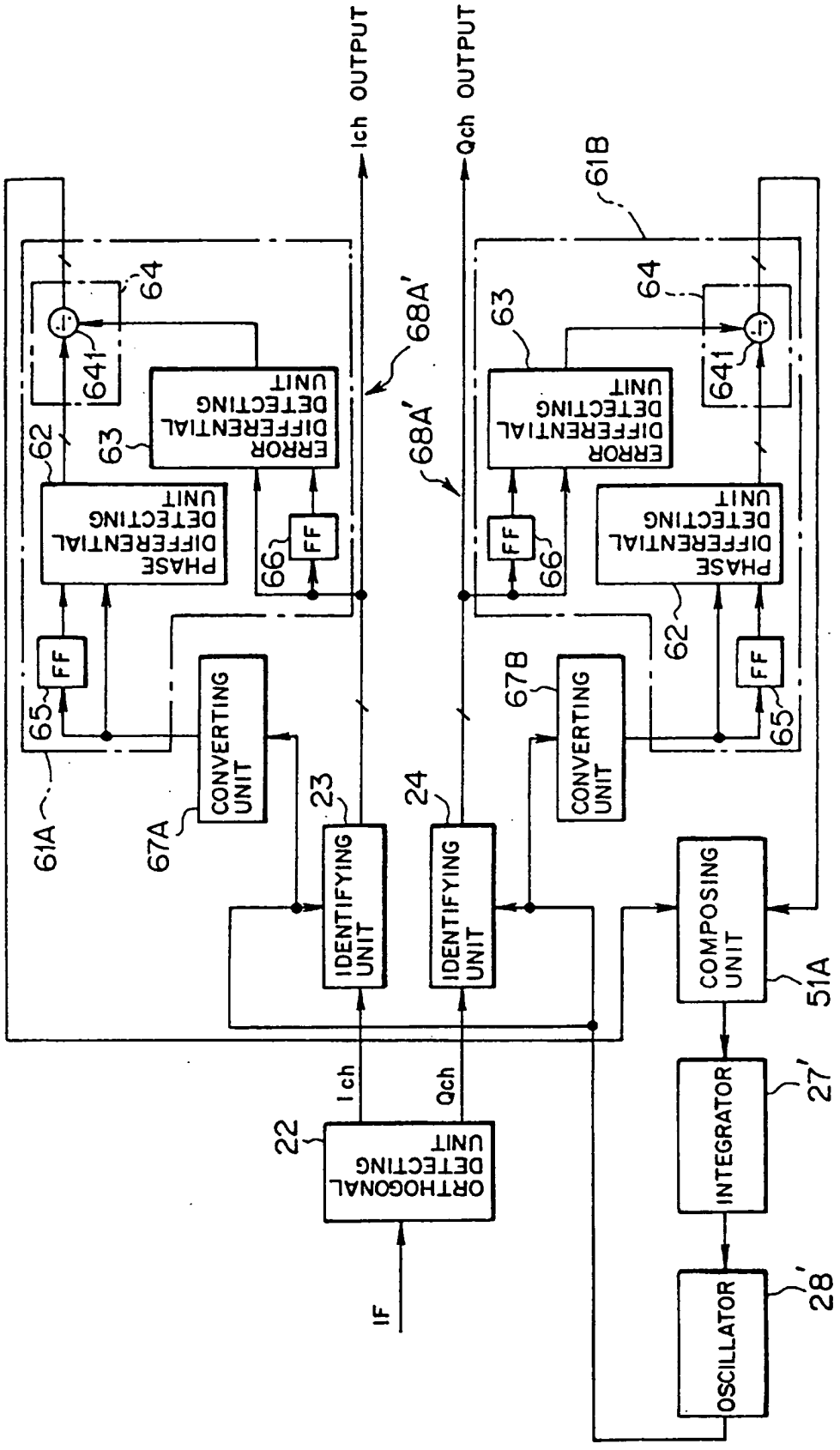

Ich OUTPUT
Qch OUTPUT
61B
64
641
63
ERROR DIFFERENTIAL DETECTING UNIT
68A'
62
PHASE DIFFERENTIAL DETECTING UNIT
66
FF
65
61A
67A
CONVERTING UNIT
67B
23
24
IDENTIFYING UNIT
COMPOSING UNIT
51A
Ich
Qch
22
ORTHOGONAL DETECTING UNIT
IF
INTEGRATOR
27'
OSCILLATOR
28'

FIG. 56

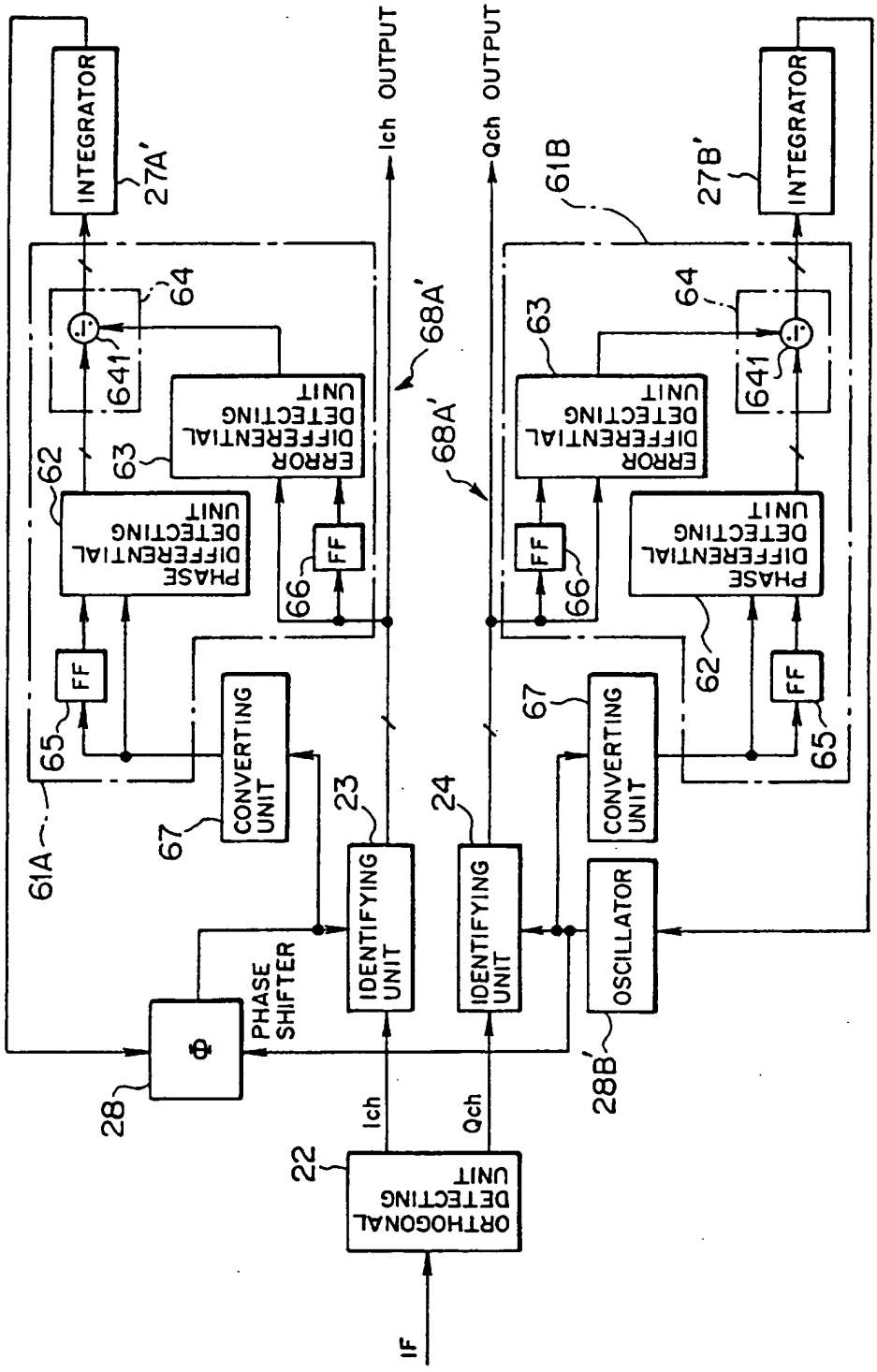

INTEGRATOR
27A'
Ich OUTPUT
Qch OUTPUT
61B
27B'
INTEGRATOR
64
641
63
ERROR DIFFERENTIAL DETECTING UNIT
62
PHASE DIFFERENTIAL DETECTING UNIT
FF
66
68A'
68A'
65
67
CONVERTING UNIT
61A
23
24
IDENTIFYING UNIT
IDENTIFYING UNIT
OSCILLATOR
28B'
PHASE SHIFTER
Φ
28
Ich
Qch
22
ORTHOGONAL DETECTING UNIT
IF

FIG.57

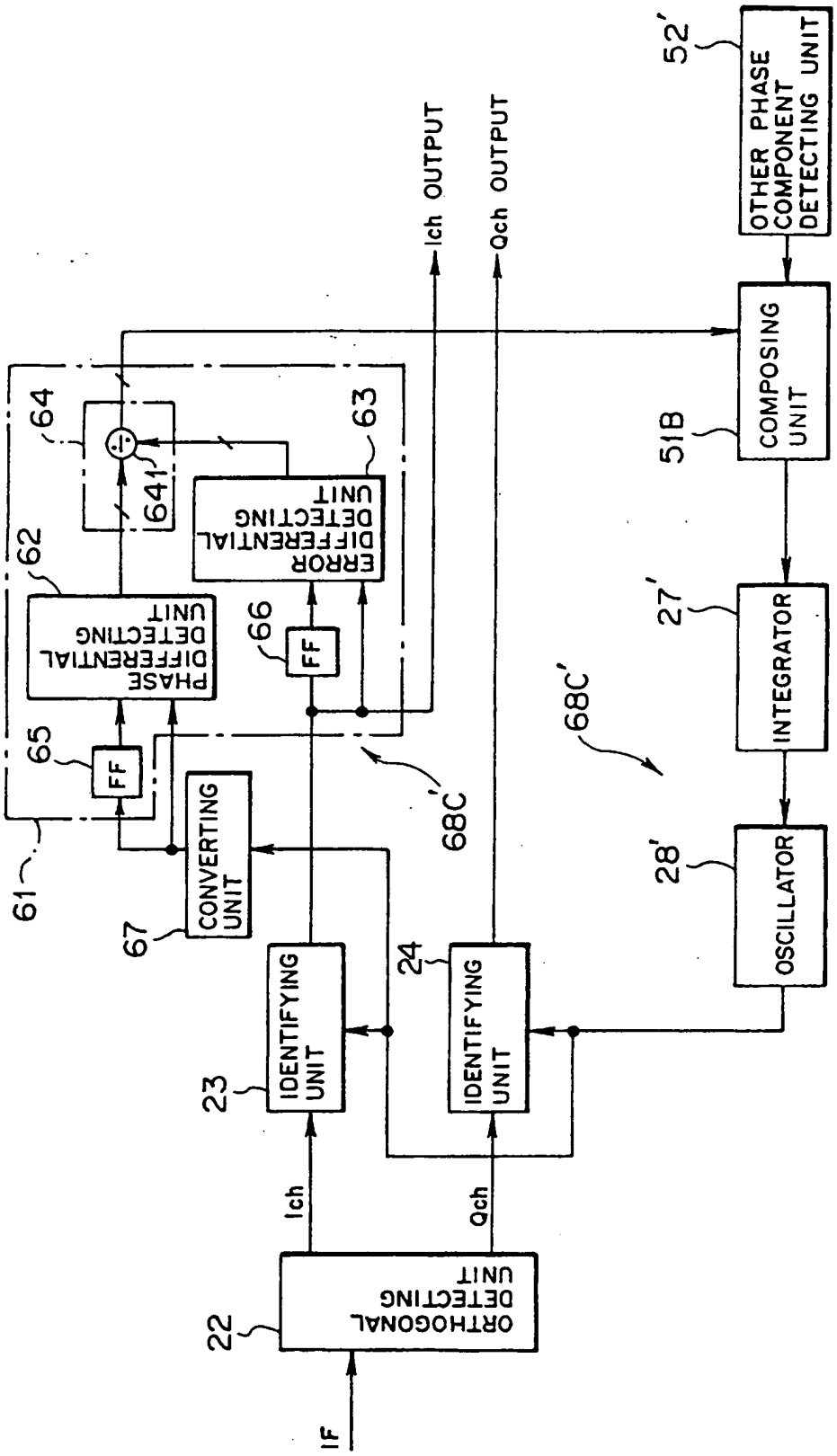

IF
ORTHOGONAL DETECTING UNIT
22
Ich
Qch
IDENTIFYING UNIT
23
IDENTIFYING UNIT
24
CONVERTING UNIT
67
61
68C'
68C
FF
65
FF
66
PHASE DIFFERENTIAL DETECTING UNIT
62
ERROR DIFFERENTIAL DETECTING UNIT
63
64
÷
641
OSCILLATOR
28'
INTEGRATOR
27'
COMPOSING UNIT
51B
OTHER PHASE COMPONENT DETECTING UNIT
52'
Ich OUTPUT
Qch OUTPUT

FIG. 58

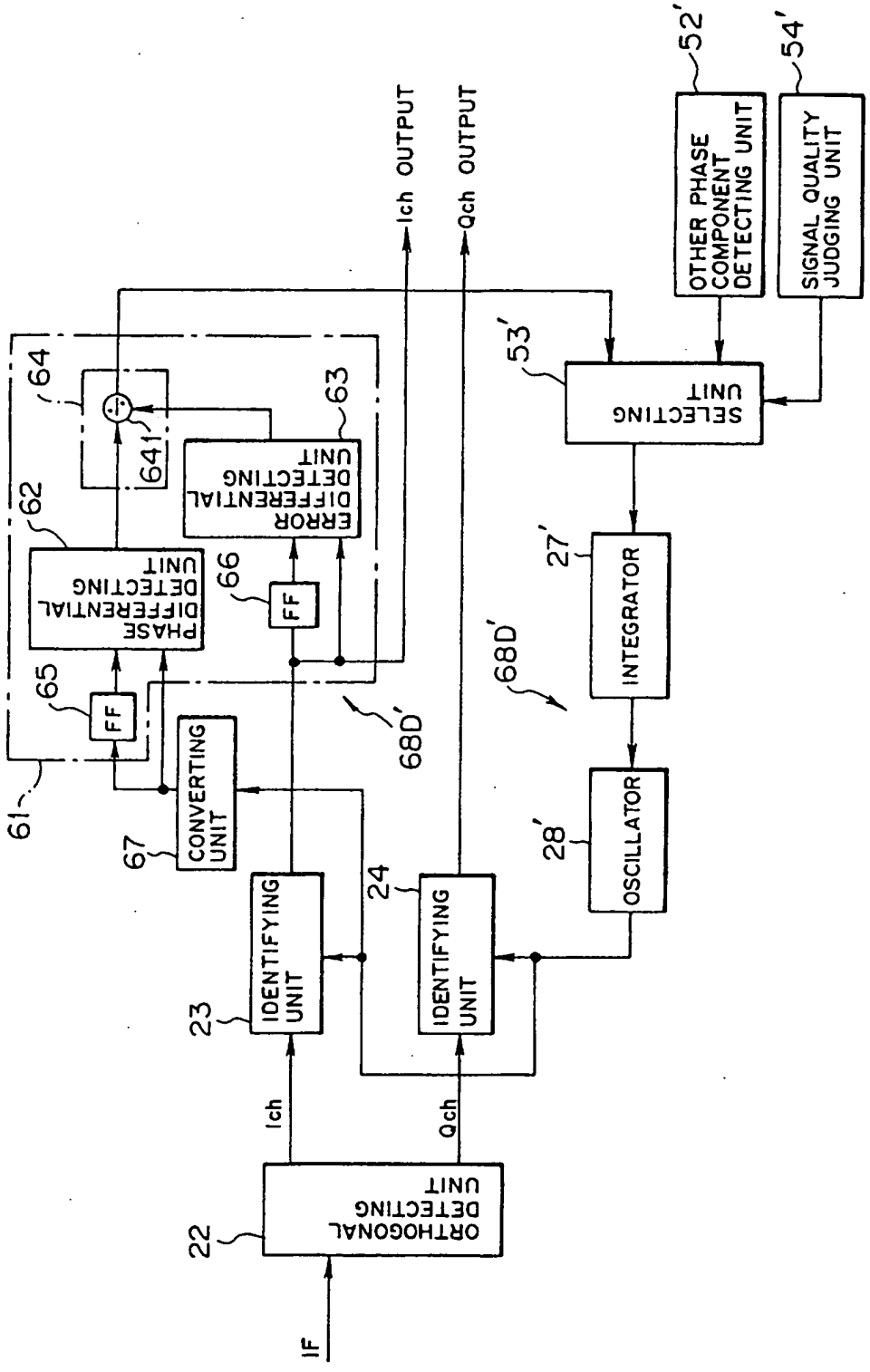

IF
ORTHOGONAL DETECTING UNIT
22
Ich
Qch
IDENTIFYING UNIT
23
IDENTIFYING UNIT
24
CONVERTING UNIT
67
61
FF
65
PHASE DIFFERENTIAL DETECTING UNIT
62
FF
66
ERROR DIFFERENTIAL DETECTING UNIT
63
641
64
68D'
OSCILLATOR
28'
INTEGRATOR
27'
68D'
SELECTING UNIT
53'
OTHER PHASE COMPONENT DETECTING UNIT
52'
SIGNAL QUALITY JUDGING UNIT
54'
Ich OUTPUT
Qch OUTPUT

FIG. 59

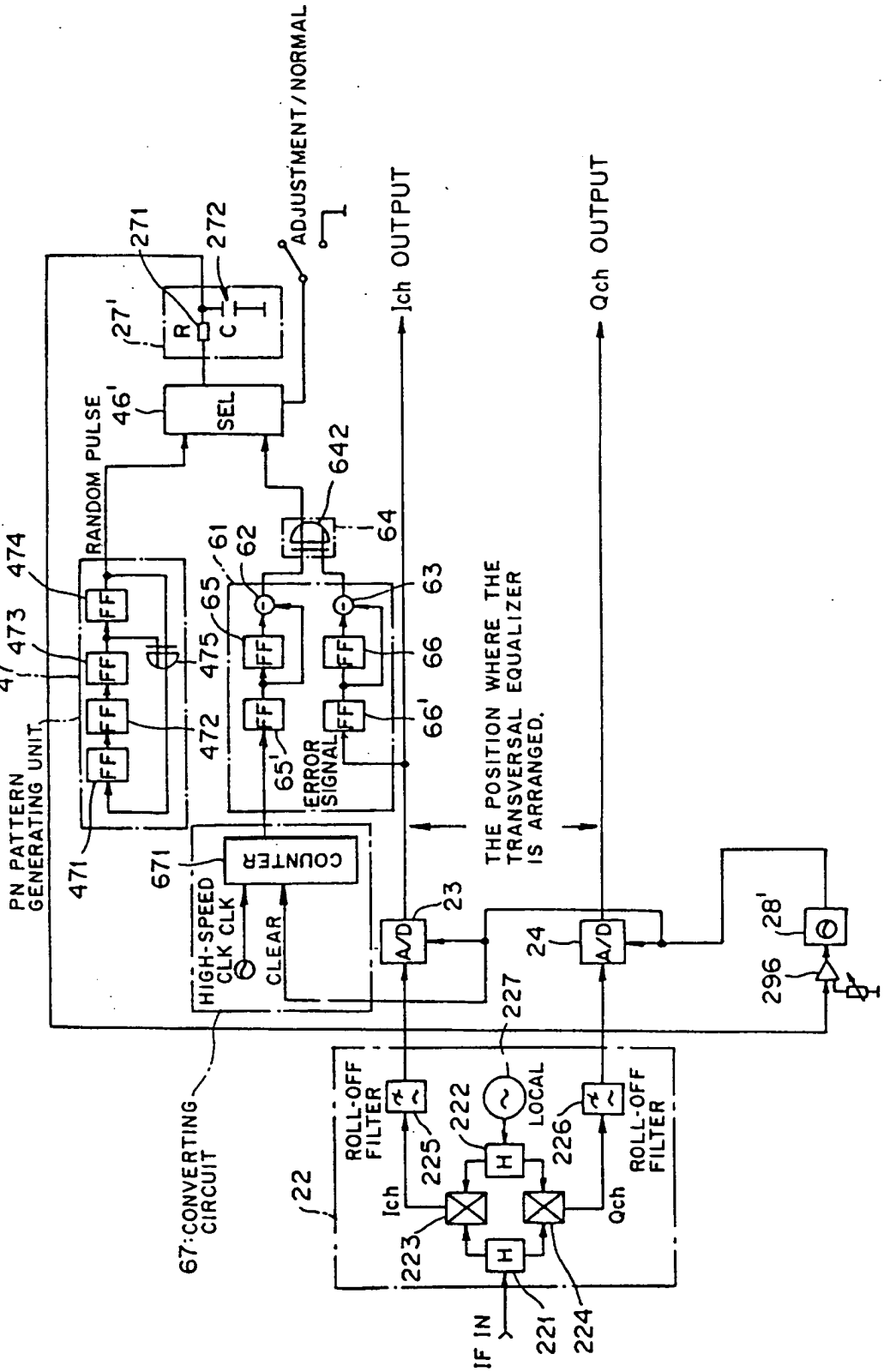
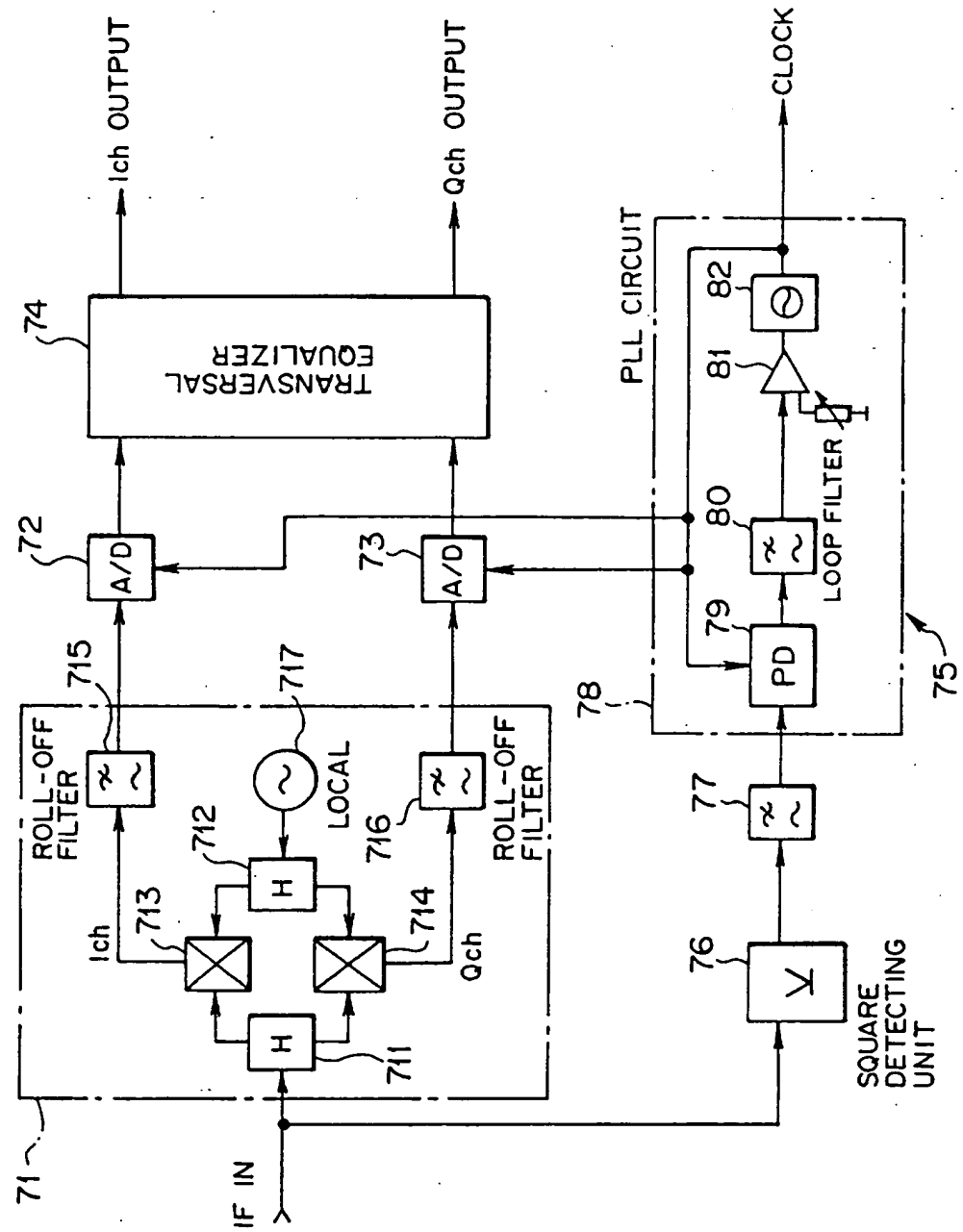

ADJUSTMENT / NORMAL
Ich OUTPUT
Qch OUTPUT
271
272
27'
R
C
SEL
46'
RANDOM PULSE
642
64
61
62
63
474
473
47'
475
65
66
66'
472
65'
ERROR SIGNAL
PN PATTERN GENERATING UNIT
471
671
COUNTER
HIGH-SPEED CLK CLK
CLEAR
THE POSITION WHERE THE TRANSVERSAL EQUALIZER IS ARRANGED.
A/D
23
24
227
28'
296
67:CONVERTING CIRCUIT
22
ROLL-OFF FILTER
225
222
LOCAL
226
Ich
Qch
223
H
IF IN
221
224

FIG.60
PRIOR ART



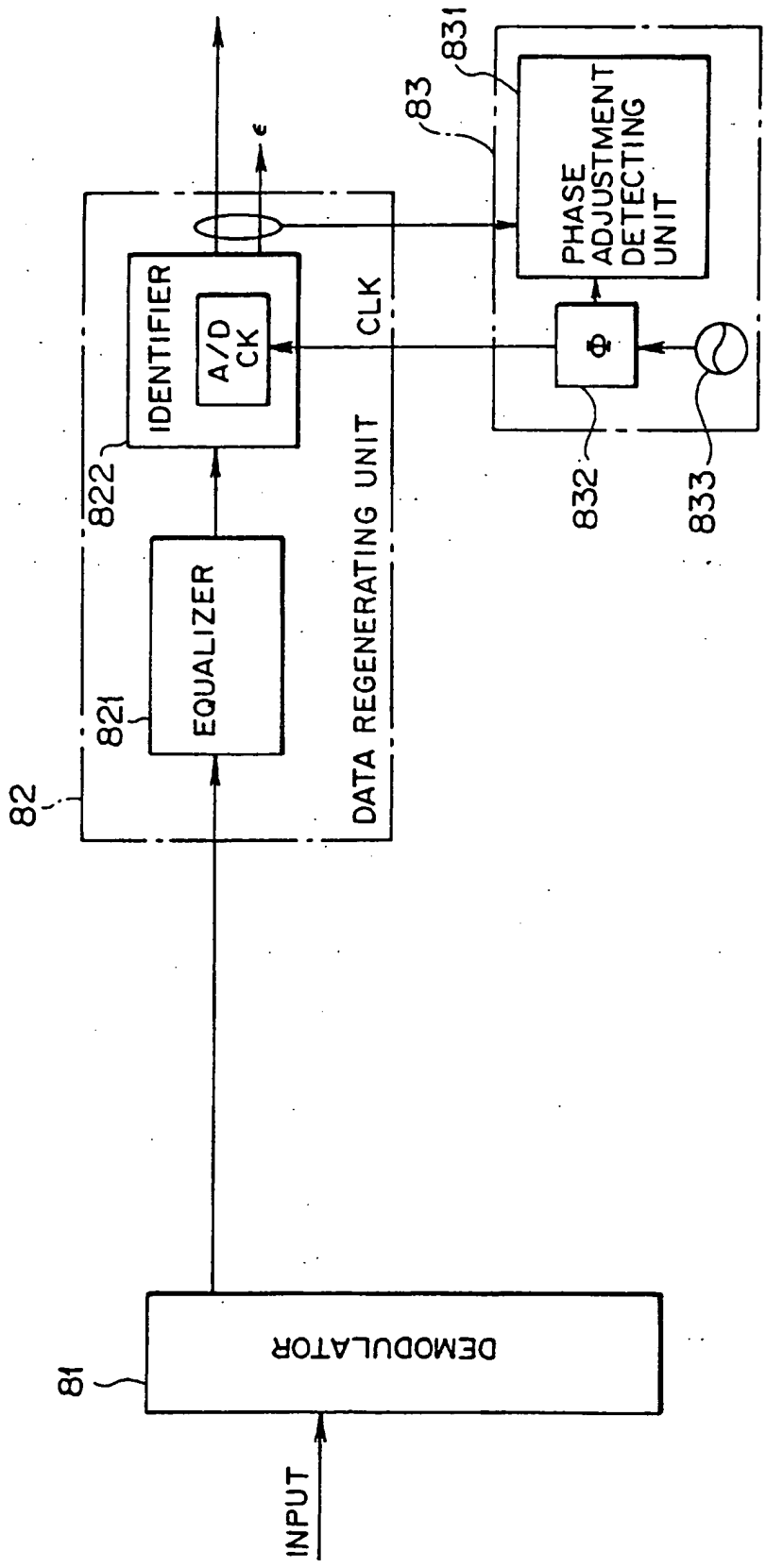


FIG. 61
PRIOR ART